

**Project Manual**

# **Battery Park City Authority**

## **New York City Police Memorial Expansion**

**200 Liberty Street, 24<sup>th</sup> Floor  
New York, New York 10281**

**ISSUED FOR PERMITTING AND BIDDING**

October 16, 2019

Page Project No. 818006



**Professional Seals**

**Battery Park City Authority**  
**New York City Police Memorial**  
**Expansion**

**200 Liberty Street, 24<sup>th</sup> Floor**  
**New York, New York 10281**

**ISSUED FOR PERMITTING AND BIDDING**

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**Architect**

**Structural  
Engineer**

**Electrical  
Engineer**

**DOCUMENT 000110 - TABLE OF CONTENTS**

SECTION	SECTION TITLE
<b>INTRODUCTORY INFORMATION</b>	
000101	Title Page
000107	Professional Seals
000110	Table of Contents
<b>DIVISION 01 - GENERAL REQUIREMENTS</b>	
011000	Summary
012500	Substitution Procedures
013100	Project Management and Coordination
013200	Construction Progress Documentation
013233	Photographic Documentation
013300	Submittal Procedures
013516	Alteration Project Procedures
014000	Quality Requirements
014200	References
015000	Temporary Facilities and Controls
016000	Product Requirements
017300	Execution
017419	Construction Waste Management and Disposal
017700	Closeout Procedures
017823	Operation and Maintenance Data
017839	Project Record Documents
017900	Demonstration and Training
<b>DIVISION 02 – EXISTING CONDITIONS</b>	
024119	Selective Demolition
<b>DIVISION 03 - CONCRETE</b>	
033000	Cast-In-Place Concrete
<b>DIVISION 04 - MASONRY</b>	
044200	Exterior Stone Cladding
<b>DIVISION 05 - METALS</b>	
055000	Metal Fabrications
055213	Pipe and Tube Railings
<b>DIVISION 07 - THERMAL AND MOISTURE PROTECTION</b>	
071600	Cementitious Waterproofing
079200	Joint Sealants
<b>DIVISION 26 – ELECTRICAL</b>	
260500	Common Work Results for Electrical
260519	Low-Voltage Electrical Power Conductors and Cables
260526	Grounding and Bonding for Electrical Systems
260533	Raceways and Boxes for Electrical Systems

260543	Underground Ducts and Raceway for Electrical Systems
260553	Identification for Electrical Systems
262416	Panelboards
265600	Exterior Lighting Fixtures

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

321440	Stone Paving
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**END OF TABLE OF CONTENTS**



## SECTION 011000 - SUMMARY

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under separate contracts.
4. Access to site.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and Drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

#### 1.2 PROJECT INFORMATION

A. Project Identification: New York City Police Memorial Expansion.

1. Page Project No. 818006
2. Project Location: Liberty Street Ramp at North Cove Marina.

B. Owner: Battery Park City Authority, 200 Liberty Street, 24th Floor, New York, New York 10281.

1. Owner's Representative: Anthony Buquicchio, Senior Project Manager.

C. Architect: Architect: Page Southerland Page, PC (Page), 1530 15<sup>th</sup> Street, Denver, Colorado 80202, telephone: (303) 595-0491.

D. Web-Based Project Software: Project software administered by Contractor will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

#### 1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Project Description: Demolition, renovation, and expansion of the existing New York City Police Memorial.

B. Type of Contract:

1. Project will be constructed by General Contractor under a single prime contract.

#### 1.4 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.
- B. The following work may be performed by separate contractors:
  1. Special inspections performed by Owner.

#### 1.5 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  1. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to public at all times. Do not use these areas for parking or for storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
    - c. Clamshell at site entrance must be opened for material and equipment deliveries. Provide 2 day's notice to Brookfield Properties to open clamshell.
- C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

#### 1.6 COORDINATION WITH OCCUPANTS

- A. Public Occupancy: Public will occupy surrounding site during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate public usage and Owner's operations.
  1. Maintain access to existing walkways and other adjacent occupied or used facilities. Do not close or obstruct walkways or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
  2. Notify Owner not less than 72 hours in advance of activities that will affect adjacent operations.

#### 1.7 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. Hours of Work: Work hours are not restricted; work may be performed during normal working hours.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
  1. Notify Owner not less than two days in advance of proposed utility interruptions.
  2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
  1. Notify Owner not less than two days in advance of proposed disruptive operations.
  2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Restricted Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

## 1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  2. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words as singular, as the context indicates.
  3. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
  1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 011000**

## **SECTION 012500 - SUBSTITUTION PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

#### **1.2 DEFINITIONS**

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

#### **1.3 ACTION SUBMITTALS**

- A. Substitution Requests: Submit a request for each substitution. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use copy of form provided at end of this Section.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
    - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Term. If specified product or method of construction cannot be provided within the Contract Term, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Price.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 7 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

## 1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

## 1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 7 days prior to time required for preparation and review of related submittals.
  - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Substitution request is fully documented and properly submitted.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.
    - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 7 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
  - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
    - b. Requested substitution does not require extensive revisions to the Contract Documents.
    - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.

- d. Substitution request is fully documented and properly submitted.
- e. Requested substitution will not adversely affect Contractor's construction schedule.
- f. Requested substitution has received necessary approvals of authorities having jurisdiction.
- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 012500**



## SUBSTITUTION REQUEST

PROJECT		SUBSTITUTION REQUEST NO.
CHECK APPROPRIATE BOX <input type="checkbox"/> SUBSTITUTION PRIOR TO BID OPENING <input type="checkbox"/> SUBSTITUTION FOLLOWING AWARD (Maximum of 7 working days from Notice To Proceed per Section 012500)		ARCHITECT'S PROJECT NO.
FROM BIDDER/CONTRACTOR (Print Company Name)		
TO ARCHITECT/ENGINEER (Print Company name)		
Bidder/contractor hereby requests acceptance of the following product or systems as a substitution in accordance with the provisions of the Contract Documents:		
SPECIFICATION TITLE		DESCRIPTION
SECTION NO.	ARTICLE/PARAGRAPH	<input type="checkbox"/> Point-by-point comparison attached – <b>REQUIRED BY A/E</b>
Reason for not providing specified item: <div style="border-bottom: 1px solid black; height: 20px; margin-bottom: 5px;"></div> <div style="border-bottom: 1px solid black; height: 20px;"></div>		
<b>QUALITY COMPARISON</b>		
	SPECIFIED PRODUCT	PROPOSED SUBSTITUTION
MANUFACTURER		
NAME, BRAND		
CATALOG/MODEL NO.		
VENDOR/DISTRIBUTOR		
MANUFACTURING LOCATION		
WARRANTY		
DOCUMENTED YEARS PROPOSED PRODUCT HAS BEEN MANUFACTURED <input type="checkbox"/> New Product <input type="checkbox"/> 2 - 5 years old <input type="checkbox"/> 5 - 10 years old <input type="checkbox"/> More than 10 years old		
SUPPORTING DATA ATTACHED <input type="checkbox"/> Drawings <input type="checkbox"/> Product Data <input type="checkbox"/> Samples <input type="checkbox"/> Tests <input type="checkbox"/> Reports <input type="checkbox"/> Other		
Differences between proposed substitution and specified product: <div style="border-bottom: 1px solid black; height: 20px; margin-bottom: 5px;"></div> <div style="border-bottom: 1px solid black; height: 20px;"></div>		
Proposed substitution affects other parts of Work: <input type="checkbox"/> No <input type="checkbox"/> Yes, explain: <div style="border-bottom: 1px solid black; height: 20px; margin-bottom: 5px;"></div> <div style="border-bottom: 1px solid black; height: 20px;"></div>		
Substitution requires dimensional revision or redesign of structure or A/E work: <input type="checkbox"/> No <input type="checkbox"/> Yes, explain: <div style="border-bottom: 1px solid black; height: 20px; margin-bottom: 5px;"></div> <div style="border-bottom: 1px solid black; height: 20px;"></div>		
Savings to Owner for accepting substitution: _____ (\$ _____)		
Proposed substitution changes Contract Term: <input type="checkbox"/> No <input type="checkbox"/> Yes      [Add]      [Deduct] _____ days		

<b>PREVIOUS INSTALLATIONS OF PROPOSED PRODUCT</b> (Provide three, minimum)			
PROJECT		ARCHITECT/ENGINEER	PHONE NO.
LOCATION	DATE INSTALLED	OWNER	PHONE NO.
PROJECT		ARCHITECT/ENGINEER	PHONE NO.
LOCATION	DATE INSTALLED	OWNER	PHONE NO.
PROJECT		ARCHITECT/ENGINEER	PHONE NO.
LOCATION	DATE INSTALLED	OWNER	PHONE NO.

<b>STATEMENT OF CONFORMANCE</b>	
<p>The Undersigned certifies:</p> <ul style="list-style-type: none"> <li>Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.</li> <li>Same warranty will be furnished for proposed substitution as for specified product.</li> <li>Same maintenance service and source of replacement parts, as applicable, is available.</li> <li>Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.</li> <li>Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.</li> <li>Proposed substitution does not affect dimensions and functional clearances.</li> <li>Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.</li> <li>Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.</li> </ul>	
SUBMITTED BY	DATE
SIGNATURE	FIRM
<p>ADDITIONAL COMMENTS</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <p>—</p> <p> <input type="checkbox"/> Contractor             <input type="checkbox"/> Subcontractor             <input type="checkbox"/> Supplier             <input type="checkbox"/> Manufacturer             <input type="checkbox"/> A/E             <input type="checkbox"/> Other _____         </p>	

<b>REVIEW AND ACTION</b> (For A/E Use only)	
<p><input type="checkbox"/> Substitution is not accepted.</p> <p><input type="checkbox"/> Substitution is accepted.</p> <p><input type="checkbox"/> Substitution is accepted with the following comments:</p> <hr/> <hr/> <p><input type="checkbox"/> Resubmit substitution request with the following additional information:</p> <hr/> <hr/> <hr/>	
REVIEWED BY	DATE
SIGNATURE	FIRM

## **SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. RFIs.
  - 3. Digital project management procedures.
  - 4. Project meetings.
- B. Related Requirements:
  - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
  - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

#### **1.2 DEFINITIONS**

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.
  - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 7 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
  - 1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

#### 1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's construction schedule.
  - 2. Preparation of the schedule of values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.
  - 6. Preinstallation conferences.
  - 7. Project closeout activities.
  - 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

#### 1.5 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
  - 1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
  - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
  - 1. Project name.

2. Project number.
  3. Date.
  4. Name of Contractor.
  5. Name of Architect.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Term or the Contract Price, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716 or software-generated form with substantially the same content, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow 2-3 working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Term or the Contract Price.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of web-based Project software. Include the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number including RFIs that were returned without action or withdrawn.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

## 1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.
  - 1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
  - 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
  - 3. Digital Drawing Software Program: Contract Drawings are available in Revit and AutoCad.
  - 4. Contractor shall execute Architect's data licensing agreement.
    - a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall also execute Architect's data licensing agreement.
- B. Web-Based Project Software: All documents transmitted for purposes of administration of the contract shall be in electronic (PDF) format and transmitted via Architect's web-based Project software that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
  - 1. Besides submittals for review, information, and closeout, this procedure applies to requests for information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), field reports and meeting minutes, and any other document any participant wishes to make part of the project record.
  - 2. Contractor and Architect are required to use this service.
  - 3. It is Contractor's responsibility to submit documents in PDF format.
  - 4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
  - 5. Users of the service need an email address, Internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, [www.adobe.com](http://www.adobe.com), or Bluebeam PDF Revu, [www.bluebeam.com](http://www.bluebeam.com)), unless such software capability is provided by the service provider.
  - 6. Paper document transmittals will not be reviewed; emailed PDF documents will not be reviewed.
  - 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements to not apply to samples or color selection charts.
  - 8. Notarized documents, original requiring execution, and final pay applications shall be submitted by hand after electronic submittal.
- C. Submittal Service: The selected service is:
  - 1. Newforma Info Exchange.
- D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
- E. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

## 1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
  - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
  - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 10 days after execution of the Agreement.
  - 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Responsibilities and personnel assignments.
    - b. Tentative construction schedule.
    - c. Critical work sequencing and long lead items.
    - d. Designation of key personnel and their duties.
    - e. Lines of communications.
    - f. Use of web-based Project software.
    - g. Procedures for processing field decisions and Change Orders.
    - h. Procedures for RFIs.
    - i. Procedures for testing and inspecting.
    - j. Procedures for processing Applications for Payment.
    - k. Distribution of the Contract Documents.
    - l. Submittal procedures.
    - m. Preparation of Record Documents.
    - n. Use of the premises.
    - o. Work restrictions.
    - p. Working hours.
    - q. Owner's occupancy requirements.
    - r. Responsibility for temporary facilities and controls.
    - s. Procedures for disruptions and shutdowns.
    - t. Construction waste management and recycling.
    - u. Parking availability.
    - v. Office, work, and storage areas.
    - w. Equipment deliveries and priorities.
    - x. First aid.
    - y. Security.
    - z. Progress cleaning.
    - aa. Working hours.
  - 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility requirements.
    - k. Time schedules.
    - l. Manufacturer's written instructions.
    - m. Warranty requirements.
    - n. Compatibility of materials.
    - o. Acceptability of substrates.
    - p. Temporary facilities and controls.
    - q. Space and access limitations.
    - r. Regulations of authorities having jurisdiction.
    - s. Testing and inspecting requirements.
    - t. Installation procedures.
    - u. Coordination with other work.
    - v. Required performance results.
    - w. Protection of adjacent work.
    - x. Protection of construction and personnel.
  3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at biweekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
  2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties



involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Term.

- 1) Review schedule for next period.
- b. Review present and future needs of each entity present, including the following:
- 1) Interface requirements.
  - 2) Sequence of operations.
  - 3) Resolution of BIM component conflicts.
  - 4) Status of submittals.
  - 5) Construction waste management and recycling.
  - 6) Sequence of finish installation and indoor air quality procedures.
  - 7) Deliveries.
  - 8) Off-site fabrication.
  - 9) Access.
  - 10) Site use.
  - 11) Temporary facilities and controls.
  - 12) Work hours.
  - 13) Hazards and risks.
  - 14) Progress cleaning.
  - 15) Quality and work standards.
  - 16) Status of correction of deficient items.
  - 17) Field observations.
  - 18) Status of RFIs.
  - 19) Status of Proposal Requests.
  - 20) Pending changes.
  - 21) Status of Change Orders.
  - 22) Pending claims and disputes.
  - 23) Documentation of information for payment requests.
4. Minutes: Owner's Construction Manager will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 013100**

## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Contractor's Construction Schedule.
  - 2. Construction schedule updating reports.
  - 3. Daily construction reports.
  - 4. Site condition reports.
  - 5. Unusual event reports.
- B. Related Requirements:
  - 1. Section 013300 "Submittal Procedures" for preparing the submittal schedule.

#### 1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
  - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. PDF file.
- B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- C. Construction Schedule Updating Reports: Submit with Applications for Payment.
- D. Daily Construction Reports: Submit upon request.
- E. Site Condition Reports: Submit at time of discovery of differing conditions.
- F. Unusual Event Reports: Submit at time of unusual event.

### 1.4 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
  - 1. Review software limitations and content and format for reports.
  - 2. Verify availability of qualified personnel needed to develop and update schedule.
  - 3. Discuss constraints, including work stages area separations interim milestones and partial Owner occupancy.
  - 4. Review delivery dates for Owner-furnished products.
  - 5. Review schedule for work of Owner's separate contracts.
  - 6. Review submittal requirements and procedures.
  - 7. Review time required for review of submittals and resubmittals.
  - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
  - 9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
  - 10. Review and finalize list of construction activities to be included in schedule.
  - 11. Review procedures for updating schedule.

### 1.5 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
  - 1. Secure time commitments for performing critical elements of the Work from entities involved.
  - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
  - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
  - 1. Activity Duration: Define activities so no activity is longer than 21 days, unless specifically allowed by Architect.
  - 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  - 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
  - 4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
  - 5. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
  - 1. Phasing: Where Work consists of multiple phases, arrange list of activities on schedule by phase.
  - 2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner or Owner's contractors or suppliers.
  - 3. Products Ordered in Advance: Include a separate activity for each product.
  - 4. Owner-Furnished Products: Include a separate activity for each product.
  - 5. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Limitations of continued occupancies.
    - c. Uninterruptible services.
    - d. Partial occupancy before Substantial Completion.
    - e. Use-of-premises restrictions.
    - f. Provisions for future construction.
    - g. Seasonal variations.
    - h. Environmental control.
  - 6. Work Stages: Where appropriate to the scope of Work, indicate important stages of construction for critical portions of the Work, including, but not limited to, the following:
    - a. Mockups.
    - b. Fabrication.
    - c. Sample testing.
    - d. Deliveries.
    - e. Installation.

- f. Tests and inspections.
    - g. Adjusting.
    - h. Curing.
  - 7. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
    - a. Structural completion.
    - b. Completion of electrical installation.
    - c. Substantial Completion.
  - E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
  - F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
    - 1. Unresolved issues.
    - 2. Unanswered Requests for Information.
    - 3. Rejected or unreturned submittals.
    - 4. Notations on returned submittals.
    - 5. Pending modifications affecting the Work and the Contract Term.
  - G. Contractor's Construction Schedule Updating: Prior to each regularly scheduled progress meeting, update schedule to reflect actual construction progress and activities. Issue schedule before each meeting.
    - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
    - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
    - 3. As the Work progresses, indicate final completion percentage for each activity.
  - H. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
    - 1. Post copies in Project meeting rooms and temporary field offices.
    - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.
- 1.7 CPM SCHEDULE REQUIREMENTS
- A. General: Prepare network diagrams using AON (activity-on-node) format.
  - B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work.
  - C. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
    - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
  2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
  3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
  4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Term. Include list of nonworking days and holidays.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    - a. Preparation and processing of submittals.
    - b. Mobilization and demobilization.
    - c. Purchase of materials.
    - d. Delivery.
    - e. Fabrication.
    - f. Utility interruptions.
    - g. Installation.
    - h. Work by Owner or Owner's contractors or suppliers that may affect or be affected by Contractor's activities.
    - i. Testing and inspection.
    - j. Punch list and final completion.
    - k. Activities occurring following final completion.
  2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
  3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Term.
  4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
    - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
  2. Description of activity.
  3. Main events of activity.

4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Term.

## 1.8 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors and separate contractors at Project site.
2. Approximate count of personnel at Project site.
3. Equipment at Project site.
4. Material deliveries.
5. High and low temperatures and general weather conditions, including presence of rain or snow.
6. Testing and inspection.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events.
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Changes received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Substantial Completions authorized.
19. Construction photographs, taken weekly.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

C. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day of an occurrence.  
Distribute copies of report to parties affected by the occurrence.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 013200**



## **SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for the following:
  - 1. Periodic construction photographs.
- B. Related Requirements:
  - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.

#### **1.2 INFORMATIONAL SUBMITTALS**

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph.
- B. Digital Photographs: Submit image files within three days of taking photographs.
  - 1. Submit photos on CD-ROM or thumb-drive. Include copy of key plan indicating each photograph's location and direction.
  - 2. Identification: Provide the following information with each image description in file metadata tag:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Date photograph was taken.
    - f. Description of location, vantage point, and direction.
    - g. Unique sequential identifier keyed to accompanying key plan.

#### **1.3 QUALITY ASSURANCE**

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

#### **1.4 FORMATS AND MEDIA**

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- C. Metadata: Record accurate date and time from camera.

- D. File Names: Name media files with date and sequential numbering suffix.

#### 1.5 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
  - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Periodic Construction Photographs: Take 12 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.
  - 1. Take 3 photographs from same vantage points each week.

#### **PART 2 - PRODUCTS (Not Used)**

#### **PART 3 - EXECUTION (Not Used)**

**END OF SECTION 013233**

## **SECTION 013300 - SUBMITTAL PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

**A. Section Includes:**

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

**B. Related Requirements:**

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
5. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
6. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
7. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

#### **1.2 DEFINITIONS**

- A. Action Submittals:** Written and graphic information and physical samples that require Architect's responsive action.
- B. Informational Submittals:** Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

#### **1.3 SUBMITTAL SCHEDULE**

- A. Submittal Schedule:** Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required

- to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
  4. Format: Arrange the following information in a tabular format:
    - a. Scheduled date for first submittal.
    - b. Specification Section number and title.
    - c. Name of subcontractor.
    - d. Description of the Work covered.
    - e. Scheduled date for Architect's final release or approval.

#### 1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
  1. Project name.
  2. Date.
  3. Name of Architect.
  4. Name of Contractor.
  5. Name of firm or entity that prepared submittal.
  6. Names of subcontractor, manufacturer, and supplier.
  7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
  8. Category and type of submittal.
  9. Submittal purpose and description.
  10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
  11. Drawing number and detail references, as appropriate.
  12. Indication of full or partial submittal.
  13. Location(s) where product is to be installed, as appropriate.
  14. Other necessary identification.
  15. Remarks.
  16. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Submittals for Web-Based Project Software: Prepare submittals as PDF files, or other format indicated by Project software website.

#### 1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections.

1. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Term will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  1. Initial Review: Allow 7 consecutive working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 7 consecutive working days for review of each resubmittal.
  4. Concurrent Review: Where concurrent review of submittals by Architect's, consultants, Owner, or other parties is required, allow 14 days for initial review of each submittal. Specification Sections having submittals requiring concurrent review include, but are not limited to:
    - a. Division 5 Section for Structural Steel, Metal Deck, and Miscellaneous Metal Fabrications.
    - b. Division 8 Sections for Doors, Frames, Door Hardware, Storefronts and Curtainwalls, and Glazing.
    - c. Division 11 Section for Electrically Operated Items of Equipment.
    - d. Division 21, 22, and 23 Sections for Plumbing Fixtures and Trim, Air Distributions Devices, Sheet Metal Work and A/C Controls.
    - e. Division 26 Sections for Wiring Devices, Lighting Fixtures, Fire Alarm and Detection System, Telephone System, and Intercommunication System.
- D. Resubmittals: Make resubmittals in same form as initial submittal.
  1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

## 1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
  - 3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  - 4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  - 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
  - 1. Electronic copies: Revit models of electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals without a properly executed "PageSoutherlandPage Release Transfer of Electronic Documents".
  - 2. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
  - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable Specification Section.
    - f. Specification paragraph number and generic name of each item.
  3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
  4. Web-Based Project Software: Submit transmittal in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
  5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit two full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
  7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit two sets of Samples. Architect will retain one Sample set; Architect will mark up and return a pdf of the submittal to confirm selections.
      - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit two sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.

- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
  - 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
  - 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  - 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  - 4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
  - 5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
  - 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
  - 1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
  - 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
  - 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
  - 4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
  - 5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
  - 6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
    - a. Name of evaluation organization.
    - b. Date of evaluation.



- c. Time period when report is in effect.
- d. Product and manufacturers' names.
- e. Description of product.
- f. Test procedures and results.
- g. Limitations of use.

#### 1.7 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

#### 1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
  - 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

#### 1.9 ARCHITECT'S REVIEW

- A. Submittals: Architect will review each submittal and indicate corrections or revisions required.
  - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 013300**

## **SECTION 013516 - ALTERATION PROJECT PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes: General provisions and requirements pertaining to altering, removing and relocating Work in existing buildings.
  - 1. Take all necessary precautions to keep unauthorized persons out of the Work areas. Secure Work areas from entry when Work is not in progress.
  - 2. Perform all alterations, remodeling, demolition, removal and relocation of Work in strict accordance with Owner's instructions and applicable Federal, State and local health and safety standards, codes and ordinances. Where conflicts occur, the more restrictive requirement shall govern.
- B. Related Sections:
  - 1. Section 024119 "Selective Demolition."

#### **1.2 EXISTING CONDITIONS**

- A. Obvious existing conditions, installations and obstructions affecting the Work shall be taken into consideration as necessary Work to be done, the same as though they were completely shown or described.
- B. Items of existing construction indicated to remain upon completion of the Work, but which require removal to complete the Work, shall be carefully removed and replaced as required. The replaced Work shall match its condition at the start of the Work unless otherwise required.
- C. Visit the site to determine by inspection all existing conditions, including access to the site, the nature of structures, objects and materials to be encountered, and all other facts concerning or affecting the Work. Information on the Drawings showing existing conditions does not constitute a guarantee that other items may not be found or encountered.

#### **1.3 PROJECT MEETINGS FOR ALTERATION WORK**

- A. Preliminary Conference for Alteration Work: Before starting alteration work, conduct conference at Project site.
  - 1. Attendees: In addition to representatives of Owner, Architect, and Contractor, specialists, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
  - 2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
    - a. Alteration Work Subschedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
    - b. Fire-prevention plan.
    - c. Governing regulations.

- d. Areas where existing construction is to remain and the required protection.
  - e. Sequence of alteration work operations.
  - f. Storage, protection, and accounting for salvaged and specially fabricated items.
  - g. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
  - h. Qualifications of personnel assigned to alteration work and assigned duties.
  - i. Requirements for extent and quality of work, tolerances, and required clearances.
  - j. Embedded work such as flashings and lintels, special details, collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.
3. Reporting: Record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.

#### 1.4 MATERIALS OWNERSHIP

- A. Existing inscribed granite panels will be demolished as part of this Work. These panels are of interest to Owner and shall remain Owner's property.
  - 1. Carefully remove and salvage each inscribed granite panel in a manner to prevent damage, protect it from damage during transit and storage, then promptly deliver it to Owner where directed.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.

#### 1.6 QUALITY ASSURANCE

- A. Fire-Prevention Plan: Coordinate with local authorities having jurisdiction to develop a plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, alarms, detectors, and other fire-control devices. Maintain or supplement existing life safety systems as directed by the authorities throughout the duration of construction.
- B. Safety and Health Standard: Comply with ANSI/ASSE A10.6.

#### 1.7 STORAGE AND HANDLING OF SALVAGED MATERIALS

- A. Salvaged Items: All materials to be removed from the existing construction are the property of the Contractor. Remove items to be demolished from the existing construction. Storage or sale of salvaged items on site is not permitted. Burning or burying of removed materials on site is not permitted.
  - 1. Do not incorporate salvaged or used material in new construction unless authorized by the Architect.
- B. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and

taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.

## 1.8 FIELD CONDITIONS

- A. Obvious existing conditions, installations and obstructions affecting the Work shall be taken into consideration as necessary Work to be done, the same as though they were completely shown or described.
- B. Items of existing construction indicated to remain upon completion of the Work, but which require removal to perform the Work, shall be carefully removed and replaced as required. The replaced Work shall match its condition at the start of the Work unless otherwise indicated.
- C. Visit the site to determine by inspection all existing conditions, including access to the site, the nature of structures, objects and materials to be encountered, and all other facts concerning or affecting the Work. Information on the Drawings showing existing conditions does not constitute a guarantee that other items may not be found or encountered.
- D. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.

## PART 2 - PRODUCTS

### 2.1 PRODUCTS FOR PATCHING, EXTENDING AND MATCHING

- A. Contract Documents do not define products or standards of workmanship present in existing construction. Determine products by inspection and by use of the existing. Provide same or similar quality products or types of construction as that in existing structure when needed to patch or extend existing Work.
- B. If reasonably matching products are not obtainable, improve appearance by minor relocating of some existing products and grouping new ones in some pattern arranged by the Architect. Do not replace products scheduled for retaining because matching ones are not obtainable, except as directed by Contract Modification.

## PART 3 - EXECUTION

### 3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
  - 1. Use only proven protection methods, appropriate to each area and surface being protected.
  - 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
  - 3. Erect temporary barriers to form and maintain fire-egress routes.

4. Where indicated, erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
8. If Work to remain in place is damaged, restore to original condition at no additional cost to the Owner.
9. Concealed Conditions: If conditions cause changes in the Work from requirements of the Contract Documents, the Contract Price will be adjusted in accordance with the General Conditions.

B. Temporary Protection of Materials to Remain:

1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.

C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

D. Utilities: Do not interrupt existing utilities serving occupied or used facilities, except when authorized by the Owner in writing two (2) weeks in advance. Provide temporary services during interruptions to existing utilities.

1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.

1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

### 3.2 PROTECTION FROM FIRE

A. General: Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated.

2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
  - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
  1. Obtain Owner's approval for operations involving use of welding or other high-heat equipment. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
  2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
  3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
  4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
  5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
  6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B and NFPA 241.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.

### 3.3 GENERAL ALTERATION WORK

- A. Have specialty work performed only by qualified specialists.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- D. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
  1. Do not proceed with the work in question until directed by Architect.
- E. Patching, repairs, or continuations of existing Work shall be relatively imperceptible in the finished Work when viewed under finished lighting conditions from a distance of six (6) feet.

- F. Noise Producing Equipment: Minimize use of noise producing equipment. Limit excessive noise to periods of vacancy or provide sound control. Arrange schedules in advance with the Owner and Architect.

3.4 DISPOSAL OF DEBRIS

- A. Remove material, debris and rubbish resulting from Work of this Section 017419 "Construction Waste Management and Disposal." Keep all areas of Work in "broom clean" condition as the Work progresses.

**END OF SECTION 013516**



## SECTION 014000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
  - 4. Specific test and inspection requirements are not specified in this Section.
- C. Related Requirements:
  - 1. Section 013200 "Construction Progress Documentation" for developing a schedule of required tests and inspections.

#### 1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities

of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

### 1.3 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

### 1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate,

for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

## 1.5 ACTION SUBMITTALS

- A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Entity responsible for performing tests and inspections.
  - 3. Description of test and inspection.
  - 4. Identification of applicable standards.
  - 5. Identification of test and inspection methods.
  - 6. Number of tests and inspections required.
  - 7. Time schedule or time span for tests and inspections.
  - 8. Requirements for obtaining samples.
  - 9. Unique characteristics of each quality-control service.
- E. Reports: Prepare and submit certified written reports and documents as specified.
- F. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

## 1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, telephone number, and email address of testing agency.
  - 4. Dates and locations of samples and tests or inspections.

5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.
14. Test reports shall include a description of deficiencies noted, and corrective action undertaken to resolve such deficiencies.
15. Deficiencies observed shall immediately be brought to the attention of the Contractor's field superintendent, and trade foreman. In the event deficiencies are not corrected, or if an interpretation of the contract documents is required, the Testing Agency shall immediately notify the Architect and applicable engineer.
16. The Testing Agency shall maintain a deficiency list of all items not corrected and shall re-inspect the area after the deficiency has been corrected. The list shall included a description of the deficiency, the date and time the deficiency was observed, who was notified, the date of re-inspection and description of corrective action taken. Distribute the deficiency list at least once per month.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

## 1.8 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

- B. **Manufacturer Qualifications:** A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. **Fabricator Qualifications:** A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. **Installer Qualifications:** A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. **Specialists:** Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. **Testing Agency Qualifications:** An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. **Manufacturer's Technical Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. **Preconstruction Testing:** Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
  - 1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.

- e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    - f. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
  - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
- 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
  - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
  - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 5. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.
  - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 7. Demolish and remove mockups when directed unless otherwise indicated.

## 1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
- 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
  - 2. Payment for these services will be made by the Owner.
  - 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Price will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
- 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  - 2. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Associated Contractor Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspection equipment at Project site.

8. Furnish tools, samples of materials, design mixes, equipment and assistance as requested.
  9. Provide and maintain, for the sole use of the Testing Agency, adequate facilities for the safe storage and proper curing of concrete test cylinders on the project site for the first 24 hours after casting as required by ASTM C31, Method of Making and Curing Concrete Test Specimens in the Field.
  10. Build and store masonry test prisms in a manner acceptable to the Testing Agency. Prisms to be tested shall remain at the job site until moved by Testing Agency personnel.
  11. Notify Testing Agency at least 10 working days in advance of any qualification testing for welding require herein.
  12. Notify Testing Agency at least 24 hours prior to expected time for operations requiring testing or inspection services.
  13. Make arrangements with the Testing Agency and pay for additional samples and tests made for the Contractor's convenience or for retesting of failed samples.
  14. For deficiencies requiring corrective action, submit in writing a description of the deficiency and a proposed correction to the Architect. After review and approval, the proposed corrective action shall be implemented and inspected by the Testing Agency. It is the Contractor's responsibility to ascertain that the deficiency is corrected and inspected prior to the work being covered.
  15. Retention of an independent Testing Agency by the Owner shall in no way relieve the Contractor of responsibility for performing all work in accordance with contract requirement.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for the Notice to Proceed.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.
- 1.10 SPECIAL TESTS AND INSPECTIONS
- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION**

### **3.1 TEST AND INSPECTION LOG**

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.



2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Architect.
  4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

**END OF SECTION 014000**

## SECTION 014200 - REFERENCES

### PART 1 - GENERAL

#### 1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

#### 1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

### 1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; [www.aabc.com](http://www.aabc.com).
2. AAMA - American Architectural Manufacturers Association; [www.aamanet.org](http://www.aamanet.org).
3. AAPFCO - Association of American Plant Food Control Officials; [www.aapfco.org](http://www.aapfco.org).
4. AASHTO - American Association of State Highway and Transportation Officials; [www.transportation.org](http://www.transportation.org).
5. AATCC - American Association of Textile Chemists and Colorists; [www.aatcc.org](http://www.aatcc.org).
6. ABMA - American Bearing Manufacturers Association; [www.americanbearings.org](http://www.americanbearings.org).
7. ABMA - American Boiler Manufacturers Association; [www.abma.com](http://www.abma.com).
8. ACI - American Concrete Institute; (Formerly: ACI International); [www.concrete.org](http://www.concrete.org)
9. ACPA - American Concrete Pipe Association; [www.concrete-pipe.org](http://www.concrete-pipe.org).
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); [www.aeic.org](http://www.aeic.org).
11. AF&PA - American Forest & Paper Association; [www.afandpa.org](http://www.afandpa.org).
12. AGA - American Gas Association; [www.aga.org](http://www.aga.org).
13. AHAM - Association of Home Appliance Manufacturers; [www.aham.org](http://www.aham.org).
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); [www.ahrinet.org](http://www.ahrinet.org).
15. AI - Asphalt Institute; [www.asphaltinstitute.org](http://www.asphaltinstitute.org).
16. AIA - American Institute of Architects (The); [www.aia.org](http://www.aia.org).
17. AISC - American Institute of Steel Construction; [www.aisc.org](http://www.aisc.org).
18. AISI - American Iron and Steel Institute; [www.steel.org](http://www.steel.org).
19. AITC - American Institute of Timber Construction; [www.aitc-glulam.org](http://www.aitc-glulam.org).
20. AMCA - Air Movement and Control Association International, Inc.; [www.amca.org](http://www.amca.org).
21. ANSI - American National Standards Institute; [www.ansi.org](http://www.ansi.org).
22. AOSA - Association of Official Seed Analysts, Inc.; [www.aosaseed.com](http://www.aosaseed.com).
23. APA - APA - The Engineered Wood Association; [www.apawood.org](http://www.apawood.org).
24. APA - Architectural Precast Association; [www.archprecast.org](http://www.archprecast.org).
25. API - American Petroleum Institute; [www.api.org](http://www.api.org).
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; [www.asphaltroofing.org](http://www.asphaltroofing.org).
29. ASCE - American Society of Civil Engineers; [www.asce.org](http://www.asce.org).
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; [www.ashrae.org](http://www.ashrae.org).
32. ASME - ASME International; (American Society of Mechanical Engineers); [www.asme.org](http://www.asme.org).
33. ASSE - American Society of Safety Engineers (The); [www.asse.org](http://www.asse.org).
34. ASSE - American Society of Sanitary Engineering; [www.asse-plumbing.org](http://www.asse-plumbing.org).
35. ASTM - ASTM International; [www.astm.org](http://www.astm.org).

36. ATIS - Alliance for Telecommunications Industry Solutions; [www.atis.org](http://www.atis.org).
37. AWEA - American Wind Energy Association; [www.awea.org](http://www.awea.org).
38. AWI - Architectural Woodwork Institute; [www.awinet.org](http://www.awinet.org).
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; [www.awmac.com](http://www.awmac.com).
40. AWWPA - American Wood Protection Association; [www.awpa.com](http://www.awpa.com).
41. AWS - American Welding Society; [www.aws.org](http://www.aws.org).
42. AWWA - American Water Works Association; [www.awwa.org](http://www.awwa.org).
43. BHMA - Builders Hardware Manufacturers Association; [www.buildershardware.com](http://www.buildershardware.com).
44. BIA - Brick Industry Association (The); [www.gobrick.com](http://www.gobrick.com).
45. BICSI - BICSI, Inc.; [www.bicsi.org](http://www.bicsi.org).
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); [www.bifma.org](http://www.bifma.org).
47. BISSC - Baking Industry Sanitation Standards Committee; [www.bissc.org](http://www.bissc.org).
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); [www.bissc.org](http://www.bissc.org).
49. CDA - Copper Development Association; [www.copper.org](http://www.copper.org).
50. CE - Conformite Europeenne; <http://ec.europa.eu/growth/single-market/ce-marking/>
51. CEA - Canadian Electricity Association; [www.electricity.ca](http://www.electricity.ca).
52. CEA - Consumer Electronics Association; [www.ce.org](http://www.ce.org).
53. CFFA - Chemical Fabrics and Film Association, Inc.; [www.chemicalfabricsandfilm.com](http://www.chemicalfabricsandfilm.com).
54. CFSEI - Cold-Formed Steel Engineers Institute; [www.cfsei.org](http://www.cfsei.org).
55. CGA - Compressed Gas Association; [www.cganet.com](http://www.cganet.com).
56. CIMA - Cellulose Insulation Manufacturers Association; [www.cellulose.org](http://www.cellulose.org).
57. CISCA - Ceilings & Interior Systems Construction Association; [www.cisca.org](http://www.cisca.org).
58. CISPI - Cast Iron Soil Pipe Institute; [www.cispi.org](http://www.cispi.org).
59. CLFMI - Chain Link Fence Manufacturers Institute; [www.chainlinkinfo.org](http://www.chainlinkinfo.org).
60. CPA - Composite Panel Association; [www.pbmdf.com](http://www.pbmdf.com).
61. CRI - Carpet and Rug Institute (The); [www.carpet-rug.org](http://www.carpet-rug.org).
62. CRRC - Cool Roof Rating Council; [www.coolroofs.org](http://www.coolroofs.org).
63. CRSI - Concrete Reinforcing Steel Institute; [www.crsi.org](http://www.crsi.org).
64. CSA - Canadian Standards Association; [www.csa.ca](http://www.csa.ca).
65. CSA - CSA International; (Formerly: IAS - International Approval Services); [www.csa-international.org](http://www.csa-international.org).
66. CSI - Construction Specifications Institute (The); [www.csinet.org](http://www.csinet.org).
67. CSSB - Cedar Shake & Shingle Bureau; [www.cedarbureau.org](http://www.cedarbureau.org).
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); [www.cti.org](http://www.cti.org).
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; [www.dasma.com](http://www.dasma.com).
71. DHI - Door and Hardware Institute; [www.dhi.org](http://www.dhi.org).
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; [www.eciaonline.org](http://www.eciaonline.org).
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; [www.eima.com](http://www.eima.com).
77. EJMA - Expansion Joint Manufacturers Association, Inc.; [www.ejma.org](http://www.ejma.org).
78. ESD - ESD Association; (Electrostatic Discharge Association); [www.esda.org](http://www.esda.org).
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); [www.intertek.com](http://www.intertek.com).
81. EVO - Efficiency Valuation Organization; [www.evo-world.org](http://www.evo-world.org).
82. FCI - Fluid Controls Institute; [www.fluidcontrolsintstitute.org](http://www.fluidcontrolsintstitute.org).
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); [www.fiba.com](http://www.fiba.com).
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); [www.fivb.org](http://www.fivb.org).

85. FM Approvals - FM Approvals LLC; [www.fmglobal.com](http://www.fmglobal.com).
86. FM Global - FM Global; (Formerly: FMG - FM Global); [www.fmglobal.com](http://www.fmglobal.com).
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; [www.floridarooft.com](http://www.floridarooft.com).
88. FSA - Fluid Sealing Association; [www.fluidsealing.com](http://www.fluidsealing.com).
89. FSC - Forest Stewardship Council U.S.; [www.fscus.org](http://www.fscus.org).
90. GA - Gypsum Association; [www.gypsum.org](http://www.gypsum.org).
91. GANA - Glass Association of North America; [www.glasswebsite.com](http://www.glasswebsite.com).
92. GS - Green Seal; [www.greenseal.org](http://www.greenseal.org).
93. HI - Hydraulic Institute; [www.pumps.org](http://www.pumps.org).
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; [www.hpva.org](http://www.hpva.org).
97. HPW - H. P. White Laboratory, Inc.; [www.hpwhite.com](http://www.hpwhite.com).
98. IAPSC - International Association of Professional Security Consultants; [www.iapsc.org](http://www.iapsc.org).
99. IAS - International Accreditation Service; [www.iasonline.org](http://www.iasonline.org).
100. IAS - International Approval Services; (See CSA).
101. ICBO - International Conference of Building Officials; (See ICC).
102. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
103. ICEA - Insulated Cable Engineers Association, Inc.; [www.icea.net](http://www.icea.net).
104. ICPA - International Cast Polymer Alliance; [www.icpa-hq.org](http://www.icpa-hq.org).
105. ICRI - International Concrete Repair Institute, Inc.; [www.icri.org](http://www.icri.org).
106. IEC - International Electrotechnical Commission; [www.iec.ch](http://www.iec.ch).
107. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); [www.ieee.org](http://www.ieee.org).
108. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); [www.ies.org](http://www.ies.org).
109. IESNA - Illuminating Engineering Society of North America; (See IES).
110. IEST - Institute of Environmental Sciences and Technology; [www.iest.org](http://www.iest.org).
111. IGMA - Insulating Glass Manufacturers Alliance; [www.igmaonline.org](http://www.igmaonline.org).
112. IGSHPA - International Ground Source Heat Pump Association; [www.igshpa.okstate.edu](http://www.igshpa.okstate.edu).
113. ILI - Indiana Limestone Institute of America, Inc.; [www.iliai.com](http://www.iliai.com).
114. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); [www.intertek.com](http://www.intertek.com).
115. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); [www.isa.org](http://www.isa.org).
116. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
117. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); [www.isfanow.org](http://www.isfanow.org).
118. ISO - International Organization for Standardization; [www.iso.org](http://www.iso.org).
119. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
120. ITU - International Telecommunication Union; [www.itu.int/home](http://www.itu.int/home).
121. KCMA - Kitchen Cabinet Manufacturers Association; [www.kcma.org](http://www.kcma.org).
122. LMA - Laminating Materials Association; (See CPA).
123. LPI - Lightning Protection Institute; [www.lightning.org](http://www.lightning.org).
124. MBMA - Metal Building Manufacturers Association; [www.mbma.com](http://www.mbma.com).
125. MCA - Metal Construction Association; [www.metalconstruction.org](http://www.metalconstruction.org).
126. MFMA - Maple Flooring Manufacturers Association, Inc.; [www.maplefloor.org](http://www.maplefloor.org).
127. MFMA - Metal Framing Manufacturers Association, Inc.; [www.metalframingmfg.org](http://www.metalframingmfg.org).
128. MHIA - Material Handling Industry of America; [www.mhia.org](http://www.mhia.org).
129. MIA - Marble Institute of America; [www.marble-institute.com](http://www.marble-institute.com).
130. MMPA - Moulding & Millwork Producers Association; [www.wmmpa.com](http://www.wmmpa.com).
131. MPI - Master Painters Institute; [www.paintinfo.com](http://www.paintinfo.com).
132. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; [www.mss-hq.org](http://www.mss-hq.org).
133. NAAMM - National Association of Architectural Metal Manufacturers; [www.naamm.org](http://www.naamm.org).

134. NACE - NACE International; (National Association of Corrosion Engineers International); [www.nace.org](http://www.nace.org).
135. NADCA - National Air Duct Cleaners Association; [www.nadca.com](http://www.nadca.com).
136. NAIMA - North American Insulation Manufacturers Association; [www.naima.org](http://www.naima.org).
137. NBGQA - National Building Granite Quarries Association, Inc.; [www.nbgqa.com](http://www.nbgqa.com).
138. NBI - New Buildings Institute; [www.newbuildings.org](http://www.newbuildings.org).
139. NCAA - National Collegiate Athletic Association (The); [www.ncaa.org](http://www.ncaa.org).
140. NCMA - National Concrete Masonry Association; [www.ncma.org](http://www.ncma.org).
141. NEBB - National Environmental Balancing Bureau; [www.nebb.org](http://www.nebb.org).
142. NECA - National Electrical Contractors Association; [www.necanet.org](http://www.necanet.org).
143. NeLMA - Northeastern Lumber Manufacturers Association; [www.nelma.org](http://www.nelma.org).
144. NEMA - National Electrical Manufacturers Association; [www.nema.org](http://www.nema.org).
145. NETA - InterNational Electrical Testing Association; [www.netaworld.org](http://www.netaworld.org).
146. NFHS - National Federation of State High School Associations; [www.nfhs.org](http://www.nfhs.org).
147. NFPA - National Fire Protection Association; [www.nfpa.org](http://www.nfpa.org).
148. NFPA - NFPA International; (See NFPA).
149. NFRC - National Fenestration Rating Council; [www.nfrc.org](http://www.nfrc.org).
150. NHLA - National Hardwood Lumber Association; [www.nhla.com](http://www.nhla.com).
151. NLGA - National Lumber Grades Authority; [www.nlga.org](http://www.nlga.org).
152. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
153. NOMMA - National Ornamental & Miscellaneous Metals Association; [www.nomma.org](http://www.nomma.org).
154. NRCA - National Roofing Contractors Association; [www.nrca.net](http://www.nrca.net).
155. NRMCA - National Ready Mixed Concrete Association; [www.nrmca.org](http://www.nrmca.org).
156. NSF - NSF International; [www.nsf.org](http://www.nsf.org).
157. NSPE - National Society of Professional Engineers; [www.nspe.org](http://www.nspe.org).
158. NSSGA - National Stone, Sand & Gravel Association; [www.nssga.org](http://www.nssga.org).
159. NTMA - National Terrazzo & Mosaic Association, Inc. (The); [www.ntma.com](http://www.ntma.com).
160. NWFA - National Wood Flooring Association; [www.nwfa.org](http://www.nwfa.org).
161. PCI - Precast/Prestressed Concrete Institute; [www.pci.org](http://www.pci.org).
162. PDI - Plumbing & Drainage Institute; [www.pdionline.org](http://www.pdionline.org).
163. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); <http://www.plasa.org>.
164. RCSC - Research Council on Structural Connections; [www.boltcouncil.org](http://www.boltcouncil.org).
165. RFCI - Resilient Floor Covering Institute; [www.rfci.com](http://www.rfci.com).
166. RIS - Redwood Inspection Service; [www.redwoodinspection.com](http://www.redwoodinspection.com).
167. SAE - SAE International; [www.sae.org](http://www.sae.org).
168. SCTE - Society of Cable Telecommunications Engineers; [www.scte.org](http://www.scte.org).
169. SDI - Steel Deck Institute; [www.sdi.org](http://www.sdi.org).
170. SDI - Steel Door Institute; [www.steeldoor.org](http://www.steeldoor.org).
171. SEFA - Scientific Equipment and Furniture Association (The); [www.sefalabs.com](http://www.sefalabs.com).
172. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
173. SIA - Security Industry Association; [www.siaonline.org](http://www.siaonline.org).
174. SJI - Steel Joist Institute; [www.steeljoist.org](http://www.steeljoist.org).
175. SMA - Screen Manufacturers Association; [www.smainfo.org](http://www.smainfo.org).
176. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; [www.smacna.org](http://www.smacna.org).
177. SMPTE - Society of Motion Picture and Television Engineers; [www.smpte.org](http://www.smpte.org).
178. SPFA - Spray Polyurethane Foam Alliance; [www.sprayfoam.org](http://www.sprayfoam.org).
179. SPIB - Southern Pine Inspection Bureau; [www.spib.org](http://www.spib.org).
180. SPRI - Single Ply Roofing Industry; [www.spri.org](http://www.spri.org).
181. SRCC - Solar Rating & Certification Corporation; [www.solar-rating.org](http://www.solar-rating.org).
182. SSINA - Specialty Steel Industry of North America; [www.ssina.com](http://www.ssina.com).
183. SSPC - SSPC: The Society for Protective Coatings; [www.sspc.org](http://www.sspc.org).
184. STI - Steel Tank Institute; [www.steeltank.com](http://www.steeltank.com).



185. SWI - Steel Window Institute; [www.steelwindows.com](http://www.steelwindows.com).
186. SWPA - Submersible Wastewater Pump Association; [www.swpa.org](http://www.swpa.org).
187. TCA - Tilt-Up Concrete Association; [www.tilt-up.org](http://www.tilt-up.org).
188. TCNA - Tile Council of North America, Inc.; [www.tileusa.com](http://www.tileusa.com).
189. TEMA - Tubular Exchanger Manufacturers Association, Inc.; [www.tema.org](http://www.tema.org).
190. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); [www.tiaonline.org](http://www.tiaonline.org).
191. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
192. TMS - The Masonry Society; [www.masonrysociety.org](http://www.masonrysociety.org).
193. TPI - Truss Plate Institute; [www.tpinst.org](http://www.tpinst.org).
194. TPI - Turfgrass Producers International; [www.turfgrasssod.org](http://www.turfgrasssod.org).
195. TRI - Tile Roofing Institute; [www.tilerroofing.org](http://www.tilerroofing.org).
196. UL - Underwriters Laboratories Inc.; <http://www.ul.com>.
197. UNI - Uni-Bell PVC Pipe Association; [www.uni-bell.org](http://www.uni-bell.org).
198. USAV - USA Volleyball; [www.usavolleyball.org](http://www.usavolleyball.org).
199. USGBC - U.S. Green Building Council; [www.usgbc.org](http://www.usgbc.org).
200. USITT - United States Institute for Theatre Technology, Inc.; [www.usitt.org](http://www.usitt.org).
201. WASTEC - Waste Equipment Technology Association; [www.wastec.org](http://www.wastec.org).
202. WCLIB - West Coast Lumber Inspection Bureau; [www.wclib.org](http://www.wclib.org).
203. WCMA - Window Covering Manufacturers Association; [www.wcmanet.org](http://www.wcmanet.org).
204. WDMA - Window & Door Manufacturers Association; [www.wdma.com](http://www.wdma.com).
205. WI - Woodwork Institute; [www.wicnet.org](http://www.wicnet.org).
206. WSRCA - Western States Roofing Contractors Association; [www.wsrca.com](http://www.wsrca.com).
207. WWPA - Western Wood Products Association; [www.wwpa.org](http://www.wwpa.org).

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut für Normung e.V.; [www.din.de](http://www.din.de).
2. IAPMO - International Association of Plumbing and Mechanical Officials; [www.iapmo.org](http://www.iapmo.org).
3. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
4. ICC-ES - ICC Evaluation Service, LLC; [www.icc-es.org](http://www.icc-es.org).

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; [www.usace.army.mil](http://www.usace.army.mil).
2. CPSC - Consumer Product Safety Commission; [www.cpsc.gov](http://www.cpsc.gov).
3. DOC - Department of Commerce; National Institute of Standards and Technology; [www.nist.gov](http://www.nist.gov).
4. DOD - Department of Defense; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
5. DOE - Department of Energy; [www.energy.gov](http://www.energy.gov).
6. EPA - Environmental Protection Agency; [www.epa.gov](http://www.epa.gov).
7. FAA - Federal Aviation Administration; [www.faa.gov](http://www.faa.gov).
8. FG - Federal Government Publications; [www.gpo.gov/fdsys](http://www.gpo.gov/fdsys).
9. GSA - General Services Administration; [www.gsa.gov](http://www.gsa.gov).
10. HUD - Department of Housing and Urban Development; [www.hud.gov](http://www.hud.gov).
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; [www.eetd.lbl.gov](http://www.eetd.lbl.gov).
12. OSHA - Occupational Safety & Health Administration; [www.osha.gov](http://www.osha.gov).

13. SD - Department of State; [www.state.gov](http://www.state.gov).
  14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; [www.trb.org](http://www.trb.org).
  15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; [www.ars.usda.gov](http://www.ars.usda.gov).
  16. USDA - Department of Agriculture; Rural Utilities Service; [www.usda.gov](http://www.usda.gov).
  17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; [www.ojp.usdoj.gov](http://www.ojp.usdoj.gov).
  18. USP - U.S. Pharmacopeial Convention; [www.usp.org](http://www.usp.org).
  19. USPS - United States Postal Service; [www.usps.com](http://www.usps.com).
- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; [www.gpo.gov/fdsys](http://www.gpo.gov/fdsys).
  2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
  3. DSCC - Defense Supply Center Columbus; (See FS).
  4. FED-STD - Federal Standard; (See FS).
  5. FS - Federal Specification; Available from DLA Document Services; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
    - a. Available from Defense Standardization Program; [www.dsp.dla.mil](http://www.dsp.dla.mil).
    - b. Available from General Services Administration; [www.gsa.gov](http://www.gsa.gov).
    - c. Available from National Institute of Building Sciences/Whole Building Design Guide; [www.wbdg.org/ccb](http://www.wbdg.org/ccb).
  6. MILSPEC - Military Specification and Standards; (See DOD).
  7. USAB - United States Access Board; [www.access-board.gov](http://www.access-board.gov).
  8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; [www.bearhfti.ca.gov](http://www.bearhfti.ca.gov).
  2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; [www.calregs.com](http://www.calregs.com).
  3. CDHS; California Department of Health Services; (See CDPH).
  4. CDPH; California Department of Public Health; Indoor Air Quality Program; [www.cal-iaq.org](http://www.cal-iaq.org).
  5. CPUC; California Public Utilities Commission; [www.cpuc.ca.gov](http://www.cpuc.ca.gov).
  6. SCAQMD; South Coast Air Quality Management District; [www.aqmd.gov](http://www.aqmd.gov).
  7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; [www.txforestservation.tamu.edu](http://www.txforestservation.tamu.edu).



**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 014200**

## **SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

#### **1.2 USE CHARGES**

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Price unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- D. Telecommunications Service: Pay telecommunications service use charges for telecommunications services to field office. Telecommunications services shall include:
  - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and printer.
  - 2. Telephone Land Lines: One line, minimum; one handset per line.
  - 3. Internet Connections: Minimum of one; DSL modem or faster.
  - 4. Email access.
  - 5. Cell Phones.

#### **1.3 QUALITY ASSURANCE**

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

#### 1.4 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

### PART 2 - PRODUCTS

#### 2.1 TEMPORARY FACILITIES

- A. Field Offices, General: Provide office space of sufficient size to accommodate needs of construction personnel office activities. Available space on site may be restricted; coordinate with Owner and Architect.
- B. Storage and Fabrication Sheds: Provide enclosures sized, furnished, and equipped to accommodate materials and equipment for construction operations.

#### 2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. Heating Equipment: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

### PART 3 - EXECUTION

#### 3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

### 3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
  - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### 3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Connect to existing utilities to remove effluent lawfully and in accordance with authorities having jurisdiction.
- C. Water Service: Connect to existing service with distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Temporary Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Electric Power Service: Connect to existing service with distribution system of sufficient size, capacity, and power characteristics required for construction operations.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Telephone Service: Provide temporary telephone or cell phone service.
- I. Electronic Communication Service: Provide internet access adequate to access Project electronic documents and maintain electronic communications.

### 3.4 SUPPORT FACILITIES INSTALLATION

- A. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.

2. Maintain access for fire-fighting equipment and access to fire hydrants.
- B. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
  1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
  2. Remove snow and ice as required to minimize accumulations.
- A. Waste Removal and Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
  1. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
  2. Provide containers with lids. Remove trash from site periodically.
  3. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- B. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

### 3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways.
  1. Comply with the following, whichever is more stringent:
    - a. 2012 US Environmental Protection Agency (EPA) Construction General Permit (CGP).
    - b. Local equivalent.
  2. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
  3. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
  4. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
  5. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

- D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
  - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- A. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- B. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- C. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- D. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
- E. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
  - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

### 3.6 MOISTURE AND MOLD CONTROL

- A. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
  - 1. Protect porous materials from water damage.
  - 2. Protect stored and installed material from flowing or standing water.
  - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
  - 4. Remove standing water from decks.
  - 5. Keep deck openings covered or dammed.

### 3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- B. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  2. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
  3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

**END OF SECTION 015000**

## SECTION 016000 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 012500 "Substitution Procedures" for requests for substitutions.
  - 2. Section 014200 "References" for applicable industry standards for products specified.

#### 1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications. Submit a comparable product request, if applicable.



### 1.3 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
  - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 7 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
    - a. Form of Architect's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
    - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

### 1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
  - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
  - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
  - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
  - 2. See individual identification sections in Divisions 21, 22, 23, and 26 for additional identification requirements.

### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

## **PART 2 - PRODUCTS**

### **2.1 PRODUCT SELECTION PROCEDURES**

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
  6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
    - a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Evaluation of "or equal" product status is by the Architect, whose determination is final.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    - a. Sole product may be indicated by the phrase: "Subject to compliance with requirements, provide the following: ..."
  2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    - a. Sole manufacturer/source may be indicated by the phrase: "Subject to compliance with requirements, provide products by the following: ..."
  3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
    - a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
  4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
    - a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
    - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
  6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.
    - a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."
  7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
    - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
  2. Evidence that proposed product provides specified warranty.
  3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.

4. Samples, if requested.
- B. Submittal Requirements: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 016000**

## **SECTION 017300 - EXECUTION**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Installation of the Work.
  - 3. Cutting and patching.
  - 4. Coordination of Owner-installed products.
  - 5. Progress cleaning.
  - 6. Starting and adjusting.
  - 7. Protection of installed construction.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for limits on use of Project site.
  - 2. Section 013300 "Submittal Procedures" for submitting surveys.
  - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
  - 4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

#### **1.2 DEFINITIONS**

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

#### **1.3 PREINSTALLATION MEETINGS**

- A. Cutting and Patching Conference: Conduct conference at Project site.
  - 1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
    - a. Contractor's superintendent.
    - b. Trade supervisor responsible for cutting operations.
    - c. Trade supervisor(s) responsible for patching of each type of substrate.
    - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affecting by cutting and patching operations.

2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

#### 1.4 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
  1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
  2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
    - a. Primary operational systems and equipment.
    - b. Fire separation assemblies.
    - c. Air or smoke barriers.
    - d. Fire-suppression systems.
    - e. Plumbing piping systems.
    - f. Mechanical systems piping and ducts.
    - g. Control systems.
    - h. Communication systems.
    - i. Fire-detection and -alarm systems.
    - j. Conveying systems.
    - k. Electrical wiring systems.
    - l. Operating systems of special construction.
  3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
    - a. Water, moisture, or vapor barriers.
    - b. Membranes and flashings.
    - c. Exterior curtain-wall construction.
    - d. Sprayed fire-resistive material.
    - e. Equipment supports.
    - f. Piping, ductwork, vessels, and equipment.
    - g. Noise- and vibration-control elements and systems.
  4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. General: Comply with requirements specified in other Sections.
  - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
  - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
  - 1. Description of the Work.
  - 2. List of detrimental conditions, including substrates.
  - 3. List of unacceptable installation tolerances.
  - 4. Recommended corrections.



- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

### 3.3 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned

with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  2. Allow for building movement, including thermal expansion and contraction.
  3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

### 3.4 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
  4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.5 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
  1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

### 3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
  4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.7 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

### 3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

**END OF SECTION 017300**

## **SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for the following:
  - 1. Recycling nonhazardous construction waste.
  - 2. Disposing of nonhazardous construction waste.
- B. Related Requirements:
  - 1. Division 31 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

#### **1.2 DEFINITIONS**

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- C. Recycle: Recovery of construction waste for subsequent processing in preparation for reuse.
- D. Salvage and Reuse: Recovery of construction waste and subsequent incorporation into the Work.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- B. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

#### **1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

- B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
1. Review and discuss waste management plan including responsibilities of waste management coordinator.
  2. Review requirements for documenting quantities of each type of waste and its disposition.
  3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
  4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
  5. Review waste management requirements for each trade.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION**

### **3.1 PLAN IMPLEMENTATION**

- A. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
- B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
  2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

### **3.2 RECYCLING CONSTRUCTION WASTE, GENERAL**

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
    - a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

### 3.3 RECYCLING CONSTRUCTION WASTE

#### A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

#### B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
  - a. Comply with requirements in Section 329300 "Plants" for use of clean sawdust as organic mulch.

#### C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

### 3.4 DISPOSAL OF WASTE

#### A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

#### B. Burning: Do not burn waste materials.

#### C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

### END OF SECTION



## **SECTION 017700 - CLOSEOUT PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

- B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

#### **1.2 ACTION SUBMITTALS**

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at final completion.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

#### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

#### **1.5 SUBSTANTIAL COMPLETION PROCEDURES**

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list).

- B. Submittals Prior to Substantial Completion: Complete the following prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
  5. Submit testing, adjusting, and balancing records.
  6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
  6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  8. Complete final cleaning requirements.
  9. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for final completion.

#### 1.6 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Page number.

#### 1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
1. Submit on digital media acceptable to Architect.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## **PART 3 - EXECUTION**

### **3.1 FINAL CLEANING**

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - g. Remove labels that are not permanent.
    - h. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    - i. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    - j. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
    - k. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
  - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
  - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

**END OF SECTION 017700**

## **SECTION 017823 - OPERATION AND MAINTENANCE DATA**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals.
- B. Related Requirements:
  - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

#### **1.2 CLOSEOUT SUBMITTALS**

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
  - 1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 15 days before requesting inspection for Substantial Completion. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
  - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 10 days of receipt of Architect's comments.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

#### **1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS**

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

#### 1.4 REQUIREMENTS FOR OPERATION AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  1. Title page.
  2. Table of contents.
  3. Manual contents.
- B. Title Page: Include the following information:
  1. Subject matter included in manual.
  2. Name and address of Project.
  3. Name and address of Owner.
  4. Date of submittal.
  5. Name and contact information for Contractor.
  6. Name and contact information for Architect.
  7. Names and contact information for major consultants to the Architect responsible for the products contained in the manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
  1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

**1.5 PRODUCT MAINTENANCE MANUALS**

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 017823**



## SECTION 017839 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.
- B. Related Requirements:
  - 1. Section 017700 "Closeout Procedures" for general closeout procedures.
  - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

#### 1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit copies of record Drawings as follows:
    - a. Initial Submittal:
      - 1) Submit one paper-copy set of marked-up record prints.
      - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable. Architect will return marked-up record print to Contractor for conversion into digital data files.
    - b. Final Submittal:
      - 1) Submit one paper-copy set of marked-up record prints.
      - 2) Submit record digital data files of record digital data file plots.
      - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one paper copy and annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
  - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

### 1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Architect for resolution.
  4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
    - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.

- b. Record markups in separate layers or worksets.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
  - 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  - 2. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  - 3. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor.

#### 1.4 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  - 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
  - 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file with comment function enabled.

#### 1.5 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.

- C. Format: Submit record Product Data as annotated PDF electronic file with comment function enabled.

- 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

#### 1.6 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

- B. Format: Submit miscellaneous record submittals as PDF electronic file.

- 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

#### 1.7 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

### **PART 2 - PRODUCTS**

### **PART 3 - EXECUTION**

**END OF SECTION 017839**

## **SECTION 017900 - DEMONSTRATION AND TRAINING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
- B. Training of Owner personnel in operation and maintenance is required for:
  - 1. Electrical systems and equipment.
  - 2. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
  - 1. Finishes, including flooring, wall finishes, ceiling finishes.
  - 2. Fixtures and fittings.
  - 3. Items specified in individual product Sections.

#### **1.2 INFORMATIONAL SUBMITTALS**

- A. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
  - 1. Submit to Architect for transmittal to Owner.
  - 2. Submit not less than four weeks prior to start of training.
  - 3. Revise and resubmit until acceptable.
  - 4. Provide an overall schedule showing all training sessions.
  - 5. Include at least the following for each training session:
    - a. Identification, date, time, and duration.
    - b. Description of products and/or systems to be covered.
    - c. Name of firm and person conducting training; include qualifications.
    - d. Intended audience, such as job description.
    - e. Objectives of training and suggested methods of ensuring adequate training.
    - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
    - g. Media to be used, such as slides, hand-outs, etc.
    - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- B. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
  - 1. Include applicable portion of O&M manuals.
  - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.

### 1.3 CLOSEOUT SUBMITTALS

- A. Training Manuals: Provide one copy of each training manual to be included with operation and maintenance data in accordance with Section 017823 "Operation and Maintenance Data."
- B. Training Reports:
  - 1. Identification of each training session, date, time, and duration.
  - 2. Sign-in sheet showing names and job titles of attendees.
  - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

### 1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
  - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
  - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

### 1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training sessions with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

### 1.6 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstration may be combined with Owner personnel training if applicable.
- C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
  - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
  - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

- D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.

- 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

#### 1.7 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. Owner will provide classroom and seating at no cost to Contractor.
- C. Provide training in minimum two hour segments.
- D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
  - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
  - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
  - 3. Typical uses of the O&M manuals.
- F. Product- and System-Specific Training:
  - 1. Review the applicable O&M manuals.
  - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
  - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
  - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
  - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
  - 6. Discuss common troubleshooting problems and solutions.
  - 7. Discuss any peculiarities of equipment installation or operation.
  - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
  - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
  - 10. Review spare parts and tools required to be furnished by Contractor.
  - 11. Review spare parts suppliers and sources and procurement procedures.
- G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

**PART 2 - PRODUCTS**

**PART 3 - EXECUTION**

**END OF SECTION 017900**



## **SECTION 024119 - SELECTIVE DEMOLITION**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

A. Section Includes:

1. Demolition and removal of building features and equipment to allow for additional work.
2. Salvage of existing items to be reused.

#### **1.2 MATERIALS OWNERSHIP**

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

#### **1.3 SUBMITTALS**

- A. Proposed Protection Measures: Submit informational report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

- B. Schedule of Building Demolition Activities: Indicate the following:

1. Detailed sequence of demolition work, with starting and ending dates for each activity.
2. Temporary interruption of utility services.
3. Shutoff and capping or re-routing of utility services.

- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.

1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
2. Identify demolition firm and submit qualifications.
3. Include a summary of safety procedures.

- D. Project Record Documents: Accurately record actual locations of capped and active utilities and concealed construction.

- E. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition in addition to items indicated elsewhere.

#### **1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

## 1.5 PROJECT CONDITIONS

- A. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
  - 1. Provide not less than 72 hours notice of activities that will affect operations of adjacent occupied buildings.
  - 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings and spaces.
    - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
- B. Owner and Architect assume no responsibility for portions of buildings in which areas and equipment are to be demolished.
  - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 1. Hazardous materials will be removed by Owner before start of the Work.
  - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. On-site storage or sale of removed items or materials is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- B. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

### 3.2 PREPARATION

- A. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving spaces and equipment to be demolished.
  - 1. Arrange to shut off indicated utilities with utility companies.
  - 2. If removal, relocation, or abandonment of utility services will affect adjacent occupied spaces, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. Arrange to shut off indicated utilities with utility companies.
  - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

### 3.4 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings and adjacent spaces and facilities.
- B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
  - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
  - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.

- a. Provide at least 72 hours notice to occupants of affected buildings if shutdown of service is required during changeover.
- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated.
  - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
  - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
  - 3. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent facilities to remain.
  - 4. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
  - 5. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
  - 6. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

### 3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
  - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  - 5. Maintain adequate ventilation when using cutting torches.
  - 6. Dispose of demolished items and materials promptly.
- B. Removed and Reinstalled Items:
  - 1. Clean and repair items to functional condition adequate for intended reuse.
  - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  - 3. Protect items from damage during transport and storage.
  - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

- C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- D. Explosives: Use of explosives is not permitted.

### 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4" at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."
- E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 075300 "Elastomeric Membrane Roofing" for new roofing requirements.

### 3.7 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

### 3.8 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site in accordance with Section 017300.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### 3.9 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.
  - 1. Clean roadways of debris caused by debris transport.

**END OF SECTION**

## **SECTION 033000 CAST-IN-PLACE CONCRETE**

### **Index to Articles**

<b>PART 1 - GENERAL</b>	<b>PART 2 - PRODUCTS</b>	<b>PART 3 - EXECUTION</b>
1.1 Contract Documents	2.1 Concrete Mixtures	3.1 Contractor's Inspection
1.2 Work Included	2.2 Concrete Ingredients	3.2 Formwork
1.3 Related Work	2.3 Formwork Materials	3.3 Fabrication and Placement of Reinforcement
1.4 Applicable Codes and Standards	2.4 Reinforcement Materials	
1.5 Submittals	2.5 Miscellaneous Materials	3.4 Joints
1.6 Measurements and Tolerances	2.6 Surface Treatments	3.5 Embedded Work
1.7 Testing and Inspection		3.6 Mixing and Delivery of Concrete
1.8 Quality Assurance		3.7 Placing Concrete
1.9 Product Delivery, Storage and Handling		3.8 Other Concrete Work
1.10 Job Conditions		3.9 Concrete Finishes and Treatments
1.11 Deficient Work		3.10 Curing, Hardening, Dustproofing and Protection
1.12 Professional Fees and Costs		3.11 Form Removal and Reshoring

The materials, procedures and the like given in the Drawings and in this Specification are known to Architect and, in Architect's professional judgment, provide the level of quality required for the Work. Contractor is encouraged to search the marketplace and technology for materials, procedures and the like that meet or that better those cited herein. It is anticipated that this search may provide equal-to or better products or procedures at a reduced cost, at a reduced time of construction, at improved reliability, or all three.

Alternative proposals for materials, procedures and the like in accordance with the provisions of the Contract Documents will be considered and, prior to its bid, Contractor is encouraged to submit such proposals.

## **PART 1 - GENERAL**

### **1.1 CONTRACT DOCUMENTS**

- A. Comply with Contract Documents: All Work of this Section shall comply with the requirements of the Conditions of the Contract (General, Supplementary and Special), with all Sections of Division 1 - General Requirements, with this Section of the Specifications, with the Drawings and with all other Contract Documents.
- B. Flammable Materials or materials not conforming in all respects to the fire resistive and fire safety provisions of governing regulations shall not be left in place in the Work.
- C. Disposition of and Exposure to Materials: Contractor remains fully responsible for the disposition and the exposure to persons of all materials, whether or not hazardous.
- D. Volatile Organic Compounds (VOC): Contractor remains fully responsible for the supplying of products and materials complying to the VOC limitations set forth by the *Building Code* and by governing agencies having jurisdiction.
- E. Metrication: For convenience of Contractor, S.I. units are provided in this Specification. In the event of conflict between the basic unit and the S.I. unit, the basic unit shall prevail.

### **1.2 WORK INCLUDED**

- A. Scope: Contractor shall examine all of the Contract Documents for the extent of the Work of this Section of the Specifications. That Work shall include all labor, materials, devices, plants, tools, equipment, appliances and services necessary to complete the Work as shown in the Drawings, as specified herein, as required by job conditions, and as required by governing authorities having jurisdiction, including but not limited to the following:
  - 1. Designing and testing of concrete mixes. Designing of concrete mixes shall be by Contractor's Professional Engineer licensed in the project's jurisdiction.
  - 2. Submission of Shop Drawings, samples, supporting data, mill certificates and the like.
  - 3. Furnishing, fabricating and placing of all reinforcing bars, field-applied concrete anchors, metal and plastic accessories, spacers and the like.
  - 4. Cooperation in the making of concrete testing samples, in inspecting reinforcing steel and in all other activities related to Work of this Section.
  - 5. Casting of concrete slabs, beams, walls, footings, other elements noted.
  - 6. Concrete fills and topping slabs, where shown in Architectural or Structural Drawings.
  - 7. Keys in construction joints.
  - 8. Grouting, setting and building-in of embedded items provided under other Sections of this Specification.
  - 9. Providing contraction and construction joints in concrete Work including the surface preparation and application of bonding compound where specified.
  - 10. Forming and bracing of concrete Work and the subsequent removal of formwork, bracing and the like. Design of formwork shall be by Contractor's Professional Engineer licensed in the project's jurisdiction.
  - 11. Formwork for pockets, chases, slots, reglets, depressions and openings in concrete Work required for the installation of Work specified under other Sections of this Specification.
  - 12. Finishing, curing, and protection of all concrete Work, including both hot and cold weather protection of concrete Work.

13. Hardening and dustproofing of exposed, interior concrete floors, platforms, stairs, landings and the like.
  14. Cleaning of concrete required to receive other materials.
  15. Furnishing and placing concrete where concrete Work is delayed to accept block-outs and other Work associated with Contractor's means and methods of construction.
  16. Plugging and sealing of holes potentially or actually subject to hydrostatic pressure. Exterior walls below grade shall be plugged and sealed.
  17. Self-placing, self-leveling, self-consolidating or compacting (SCC) concrete. This specification allows for the use of SCC at Contractor's option. Provide SCC where specifically required in the Contract Documents.
  18. Provisions for other Work.
  19. Cooperate with Owner, with Construction Manager, with Architect and with Testing Agency in all aspects of quality assurance and in all other activities related to the work of this Section.
  20. The safe handling and disposition of materials related to the Work of this Section, whether or not hazardous.
  21. All other labor, materials and Work given in the Drawings, specified herein or required to make the Work complete.
- B. Work Installed as Specified Elsewhere: Contractor shall examine all of the Contract Documents for the extent of Work to be installed under this Section. Such work shall include, but shall not be limited to:
1. Anchors, inserts, clips, field-applied concrete anchors and other embedded materials for precast or stonework, and the like.
  2. Angle edging, corner guards, curb edging and the like at platforms, pits, and the like.
  3. Sleeves for penetration through new concrete.
  4. Provisions for electrical and lightning grounding
  5. Embedded items of other trades similar to the items listed in this Article.

### **1.3 RELATED WORK**

- A. Related Work Specified Elsewhere, Amplified Elsewhere or Included in Other Contracts:
1. Submittals: Section 013000.
  2. Owner's plant and field testing and inspection of concrete Work by Testing Agency engaged and paid for by Owner: Section 014000.
  3. Furnishing of embedded items required by and specified under other Sections of this Specification.
  4. Other items similar to the items listed in this Article.



#### 1.4 APPLICABLE CODES AND STANDARDS

- A. General: Except as modified or voided by requirements specified herein or by details or notes included in the Drawings, Work specified under this Section shall conform to all applicable provisions of the codes, specifications, standards and other reference documents cited in this Specification and/or noted in the Drawings. In the event of conflict between provisions of stipulated reference documents and of this Specification or of another stipulated reference document, Contractor shall report in writing the details of the conflict. Decisions regarding applicability of provisions of this Specification and provisions of reference documents applied independently or as supplemented, modified or voided, will be provided in writing and shall be final. Resolution of conflicts shall conform to the procedures set forth in the General Conditions of the Contract.
- B. Codes: All Work under this Section shall conform to the requirements of the New York City Building Code, latest edition, hereinafter referred to as *Building Code*, and to the regulations of all governmental authorities having jurisdiction. Where more stringent, the following codes, standards, manuals and specifications, latest edition and revision, shall apply to the Work, all as modified herein or by *Building Code*:
1. *Standard Specification for Tolerances for Concrete Construction and Materials*, ACI 117.
  2. *Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete*, ACI 211.1.
  3. *Standard Practice for Selecting Proportions for Structural Lightweight Concrete*, ACI 211.2.
  4. *Recommended Practice for Evaluation of Strength Test Results of Concrete*, ACI 214.
  5. *Field Reference Manual: Specifications for Structural Concrete, ACI 301, with Selected ACI and ASTM References*, SP-15. Contractor shall keep at least one full copy in the field office at all times.
  6. *Guide for Measuring, Mixing, Transporting and Placing Concrete*, ACI 304.
  7. *Building Code Requirements for Structural Concrete, ACI 318 and Commentary*, ACI 318R. (referred to hereinafter as ACI Code).
  8. *Standard Specification for Cold Weather Concreting*, ACI 306.1.
  9. *Standard Practice for Curing Concrete*, ACI 308.
  10. *Guide for Consolidation of Concrete*, ACI 309.
  11. *National Design Specification for Wood Construction*, National Forest Products Association.
- C. Reference Documents: To the extent that the best quality of Work is provided, Work shall conform to the examples, procedures and recommendations listed below, latest edition and revision. Where provisions of the *Building Code*, this Specification, or codes, standards, manuals and specifications cited by this Specification are more restrictive or provide increased quality, the combination of provisions, examples, procedures and recommendations which provide both best quality and *Building Code* conformance shall control the Work.
1. *ACI Detailing Manual*, SP-66 (Includes ACI 315 and ACI 315R). Note that some aspects of SP-66 are out-of-date (bar development lengths, etc.)
  2. *ACI Concrete Terminology*, ACI CT-13.
  3. *Chemical Admixtures for Concrete*, ACI 212.3R.
  4. *Guide for the Use of High-Range Water-Reducing Admixtures (Superplasticizers) in Concrete*, ACI 212.4R.
  5. *Guide for Use of Normal Weight Aggregates in Concrete*, ACI 221R.
  6. *Use of Fly Ash in Concrete*, ACI 226.3R.
  7. *Guide for Concrete Floor and Slab Construction*, ACI 302.1R.

8. *Placing Concrete by Pumping Methods*, ACI 304.2R.
  9. *Hot Weather Concreting*, ACI 305R.
  10. *Cold Weather Concreting*, ACI 306R.
  11. *Guide for Consolidation of Concrete*, ACI 309R.
  12. *Self-Consolidating Concrete*, ACI 237R.
  13. *Guide to Formwork for Concrete*, ACI 347R with the specific deletion of reference to tolerances where in conflict with this Specification. Tolerances given in ACI 117 shall apply to the Work except where less stringent than are provided under this Specification.
  14. *Manual of Standard Practice*, Concrete Reinforcing Steel Institute.
  15. *Mechanical Connections of Reinforcing Bars*, ACI 439.3R.
  16. *Use of Epoxy Compounds with Concrete*, ACI 503R.
  17. *Guide for the Selection of Polymer Adhesives with Concrete*, ACI 503.5R.
  18. *Measurement of Properties of Fiber Reinforced Concrete*, ACI 544.2R.
  19. *Guide to Durable Concrete*, ACI 201.2R.
  20. *Qualification of Post-Installed Mechanical Anchors in Concrete*, ACI 355.2.
  21. *Qualification of Post-Installed Adhesive Anchors in Concrete*, ACI 355.4.
- D. ASTM (American Society for Testing and Materials) Specifications cited in ACI 318, ACI 301, this Specification or in cited reference documents shall be the year of adoption or tentative adoption and revision listed in the latest edition of the Annual Book of ASTM Standards, *Index*, except that, should a specific year of adoption or revision be cited by the Contract Documents, by *Building Code*, or be proposed by Contractor and be accepted by Structural Engineer, that edition shall apply to and shall control the Work.
- E. Conformance to Regulations: Work of this Section shall conform to all applicable federal, state, and local laws and regulations.

## 1.5 SUBMITTALS

- A. General: Submit samples, Shop Drawings, product data, test reports and data, manufacturer's names, certifications, procedures, methodology statements, and the like as stipulated. With the exception of samples, submittals shall be in PDF format and transmitted electronically, unless otherwise accepted.
1. Review of Contractor's submittals is only for the limited purpose of the examination of submittals for conformance with the design concept of the project and to assist Contractor in ascertaining that the information given in the submittals conforms to the requirements of the Contract Documents.
  2. Review of Contractor's submittals is not conducted for the purpose of determining the accuracy or the completeness of the submittal, for dimensions or quantities, or for installation or performance of the system or the piece(s) being submitted.
  3. Submittals by Contractor implies that Contractor has checked the submittal with care. Where by error or other cause, Contractor's check has not been accomplished, Contractor shall not rely on review but shall first check and shall then resubmit such material as though the submittal had been rejected.

B. Shop Drawings:

1. General: Shop Drawings, as the term is used under this Section, are not Contract Documents, but are intended to demonstrate the way that Contractor intends to conform to the requirements provided in the Contract Documents. Contractor may wish to use these same drawings as a part of the instructions given to craftpersons for the accomplishment of the Work.
2. Best Standards: Shop Drawings furnished under this Section shall conform to the best standards of the construction industry. Shop Drawings shall be prepared by and under the supervision of competent engineering personnel. Prior to preparation, Contractor shall retain a Professional Engineer, accepted by Construction Manager and by Structural Engineer and licensed in the project's jurisdiction, to supervise the preparation of and to check each Shop Drawing for compliance with the requirements of the Contract Documents
  - a) Shop Drawings shall be prepared under the direction of personnel completely familiar with Architectural, Mechanical, Plumbing, Electrical and other building trades Drawings.
  - b) Comply with the requirements of ACI SP-66 where more stringent than is specified herein. Show bar schedules; stirrup size and spacing, drawings of bent bars, and size and arrangement of all reinforcement.

<b>STRUCTURAL ENGINEER REVIEW</b>	
NO EXCEPTIONS TAKEN <input type="checkbox"/>	RESUBMISSION NOT REQUIRED <input type="checkbox"/>
MAKE CORRECTIONS NOTED <input type="checkbox"/>	RESUBMIT <input type="checkbox"/>
	NOT REVIEWED <input type="checkbox"/>
LERA CONSULTING STRUCTURAL ENGINEERS, RLLP	
BY: _____	
DATE: _____	

3. Shop Drawings shall be submitted for review and to governing agencies having jurisdiction for acceptance in accordance with the provisions of the Contract Documents.
4. Shop Drawings shall be submitted in parts as follows:
  - a) Sleeve, Insert and Fitting Location Drawings,
  - b) Construction Joint and Crack Control Joint Location and Detail Drawings,
  - c) Formwork Drawings,
  - d) Placing Plans and Elevations,
  - e) Detail Drawings and Schedules,
  - f) As required for the work of other trades,
  - g) Field Work Drawings, and
5. Sleeve, Insert and Fitting Location Drawings shall show clearly the location and orientation of each item to be placed into the formwork. Include items for the Work of other trades.

6. Construction Joint and Crack Control Joint Drawings shall show the location of joints and shall show also the sequence of pours and all else needed for the proper detailing of reinforcing steel. Show and detail keys and the like. Indicate extent and type of bonding compound. Submit in sufficient time to allow the orderly detailing of reinforcing steel.
7. Formwork Drawings shall include plans, elevations, sections and complete details to describe clearly, at an ample scale, all Work to be provided. Drawings shall be dimensioned accurately, where applicable, and shall be notated clearly. Detail ledges, curbs, pads, trenches, openings and the like from information given in Architectural, Structural, Plumbing, Electrical and other Contract Documents.
  - a) Show in the Formwork Drawings and dimension thereon, holes required for passage of Work of other Divisions and other Sections of this Specification through Cast-In-Place Concrete Work.
  - b) Contractor's Professional Engineer licensed in the project's jurisdiction shall be responsible for the design of formwork. As evidence of conformance with this requirement, each Formwork Drawing shall bear the seal and signature of Contractor's Professional Engineer.
8. Placing Plans and Elevations shall show, to scale with all dimensions, all concrete Work including top of slabs and depressions, pits, curbs, trenches, pads, steps, slopes, edges of slabs, openings, sleeves, blockouts and the like. Provide schedules and details showing placing sequences, bending, lengths and locations of all reinforcement. Show elevations of all concrete walls with top and bottom elevations, openings, ledges, pockets, construction joints, and all else needed to locate correctly all reinforcement. Indicate all lap lengths and lap locations in the placing plans.
  - a) Detailing of Reinforcing Steel shall recognize the arrangement and dimensioning of individual bars, including the location of bend points, hooks and the like so as to preclude interference between bars, sets of bars, and embedded items and so as to allow clear spacing and concrete cover as provided in ACI 315 and ACI 318. Prepare details and provide sections showing placement sequences to minimize congestion of reinforcing steel at splices, intersecting bars around openings and block-outs, and adjacent to embedded items. Illustrate and note correct placing arrangement and placing sequence to enable field placing crews to properly place and execute the Work. Provide sections, typical details and notes to illustrate correct location and arrangement of and clear cover for reinforcement and required placement locations. Provide suitable and necessary details and placing sequence information in Shop Drawings so as to properly instruct reinforcing steel placement personnel.
9. Detail Drawings and Schedules for reinforcing steel, including welded wire fabric (WWF), shall be prepared in strict accord with the methods and procedures provided in ACI SP-66 except that provisions of the Drawings and of this Specification shall prevail. Detail Drawings shall include bar and fabric lists; applicable bar lists shall be submitted simultaneously with related Detail Drawings. Prepare Detail Drawings which provide for reinforcement, including dowels, properly positioned in all concrete Work, so that material can be properly cut, bent and packaged from information given in Detail Drawings.
  - a) Reinforcement for concrete Work shall include all reinforcement shown or scheduled in Drawings, including all reinforcement required by typical details and general notes. Provide minimum percentages of reinforcing steel required by ACI Code where such reinforcement exceeds that stipulated in Drawings.
  - b) Reinforcement shall be spliced in strict accord with ACI 318. Where practical, stagger splices of adjacent bars.

- c) Unless shown specifically to the contrary, all reinforcement shall be spliced and all splices shall develop the full tensile capacity of the reinforcement. No reduction in splice length or development requirements may be taken because supplied reinforcing is larger than that required under the Contract.
  - d) Lapped bars may be detailed to be placed in contact and securely wired together or may be separated in accord with ACI 318 to permit embedment of the entire surface of each bar in concrete.
- 10. Field Work Drawings: Prepare Field Work Drawings depicting all field work required to accommodate field conditions. Submit to both Architect and to Structural Engineer.
- 11. Contractor shall coordinate and cross-check for accuracy, completeness and correct relationship to the Work of other Sections, each Shop Drawing prepared for the Work of this Section, including each Shop Drawing prepared by accepted subcontractors. Pay particular attention to areas of congestion of reinforcement and to areas where reinforcement and other embedded items combine to cause congestion. Contractor's check shall include a verification of compliance with the Contract Documents and shall be performed prior to submission and resubmission of each Shop Drawing. The personally inscribed initials of the person(s) preparing each shop drawing as well as the detailing agency's supervisor and chief checker shall be included in the title block or similarly prominent location.
- 12. Substitutions: Should Contractor desire a Substitution or Deviation from the Drawings or Specifications, or both, Contractor shall submit the specific request in writing prior to the submittal of Shop Drawings showing the Substitution or Deviation. Requests for Substitutions or Deviations shall be submitted on Contractor's letterhead. Substitutions and Deviations not identified, or identified only in letters of transmittal or in Shop Drawings, or both, without the required written description on Contractor's letterhead, may not be accepted and shall be sufficient cause for the rejection and the return of such Shop Drawings without further action.
  - a) Acceptance of Shop Drawings including Substitutions and Deviations not detected during Shop Drawing review, shall not relieve Contractor from responsibility to conform strictly to the Contract Documents. Substitutions and deviations will be allowed only where permitted in writing.
  - b) Architect is the sole judge of the suitability of Contractor-proposed substitutions. Review of Contractor-proposed substitutions and deviations is subject to the compensation provisions of Article 1.12.
- 13. Shop Drawing Review: Only Shop Drawings marked "No Exceptions Taken" or "Make Corrections Noted - Resubmission Not Required" may be used by Contractor in the Work. Shop Drawings marked "Make Corrections Noted - Resubmit" shall be corrected or completed (or both) as required and shall be resubmitted. This process shall be repeated the number of times required to achieve the mark "No Exceptions Taken" or "Make Corrections Noted - Resubmission Not Required". An example of Structural Engineer's Shop Drawing review stamp is shown here for reference.
  - a) Nonconformities and errors detected during review will be noted in Shop Drawings returned to Contractor upon completion of review. Acceptance of Shop Drawings including Substitutions and Deviations not detected during review will not relieve Contractor from sole responsibility to provide Work conforming strictly to the Contract Documents.
  - b) Shop Drawing review includes engineering calculations only to the extent deemed necessary to ascertain that Contractor's Shop Drawings have been prepared by competent personnel. Contractor alone is responsible for the accuracy and the completeness of Contractor's engineering calculations.

- c) Review of Contractor's Shop Drawings does not include a review of bills of materials and the like. Accordingly, information required for the review of Shop Drawings shall be contained outside of bills of materials and the like.
  - 14. Resubmission of Shop Drawings: Prior to resubmission of Shop Drawings with additions, deletions, or corrections, Contractor shall cloud and identify all changes from the prior issue. Drawings submitted without each change both clouded and identified clearly will be returned and shall be resubmitted as though the original submittal had been rejected. Each submittal, whether or not accepted or rejected, shall contain a unique revision number, clearly identified.
  - 15. Shop Drawing Log: Contractor shall number Shop Drawings, and revisions to Shop Drawings, in a form acceptable both to Contractor and to Architect/Structural Engineer. Structural Engineer will provide to Contractor in its letters of transmittal both the log-in and the log-out date of each Shop Drawing. Further, on request of Contractor, Structural Engineer will provide to Contractor aged listings of each Shop Drawing remaining in the office of Structural Engineer.
- C. Product Data: Submit printed manufacturer's literature for each manufactured item specified under Part 2 - Products, along with test data as may be requested. Include detailed instructions for application and installation.
- D. Names of Manufacturers/Suppliers: Where to be used, submit for acceptance the names of following products along with certification that the products conform in all respects to the requirements of the Contract Documents:
- 1. cement
  - 2. aggregates
  - 3. admixtures
  - 4. silica fume (microsilica), fly ash, blast furnace slag, and other natural pozzolans
  - 5. fibrous reinforcement
  - 6. ready-mix concrete
  - 7. form faces
  - 8. form sealers and release agents
  - 9. form-ties
  - 10. reinforcing bars
  - 11. non-shrink grout and epoxy grout
  - 12. bonding compound and epoxy adhesive
  - 13. polymer patching/feathering compound
  - 14. post-installed anchors
  - 15. polyurethane sealant
  - 16. joint filler and compressible filler
  - 17. cellular glass and cellular polystyrene
  - 18. bond breaker
  - 19. moisture-retaining covers
  - 20. curing and sealing, strippable curing compound, and liquid/sealer densifier
  - 21. evaporation retarder
  - 22. waterproofing and chloride ion screen
  - 23. concrete cleaning/finishing solution
  - 24. other products, material and fixtures, as specified herein
- E. Mill Tests: Submit certified mill test reports for cement, for steel reinforcement, including bars, welded wire fabric and dowels,. Provide also to governing agencies having jurisdiction.
- 1. Mill test reports shall state clearly the governing ASTM specification and shall be certified and notarized by Contractor as conforming in all respects to that specification.

- F. Reinforcing Bar Mechanical Connections: Obtain from manufacturer and submit a certified affidavit indicating compatibility of reinforcement, including bar deformations, with mechanical connection assemblies.
- G. Certification for Curing Compounds and Sealers, Hardeners, Dustproofing, etc.: Submit certificate of compatibility with concrete and with materials to be applied to concrete surface.
- H. Certification for Admixtures: Submit notarized document of compatibility of each admixture with all other concrete ingredients and with each applicable concrete surface treatment.
- I. Design Mixes as provided in Part 2 of this Specification. Submit proposed mix designs for both concrete and grout on the Mix Design Submittal Form included with this specification. Submit test results and other supporting data on each mix design.
- J. Post-Installed Anchor Certificates: Submit approved independent testing report per ACI 355 (ICC-ES report), Manufacturer's Printed Installation Instructions, letter describing installation procedures, and installer qualifications including certification for horizontal and overhead adhesive installation where applicable.
- K. Protective Measures: Contractor's construction procedures shall be typewritten and shall include charts and diagrams, as applicable and necessary, to explain fully the proposed procedures, methods, equipment and operations in order to allow review, assist the Testing Agency's evaluation of the Work, and to allow Contractor's personnel to perform Work in full conformance to the Contract Documents. Submit procedures for the following:
  - 1. Both hot, normal and cold weather concreting procedures shall be submitted not less than four weeks before beginning the Work of this Section, regardless of the need for the immediate implementation of such procedures. Procedures shall include hot weather cooling systems, cold weather heating systems, insulation, enclosures, and the like. Finishing procedures and timing and duration of curing shall be described.
  - 2. Protection of concrete against injury due to mechanical contact and construction operations.
  - 3. Protection of Work by other trades.
  - 4. Formwork removal and reshoring procedures. Procedures unique to hot and cold weather conditions shall be identified. Shoring and reshoring drawings and calculations shall be prepared under the supervision of and signed and sealed by Contractor's Professional Engineer.
  - 5. Procedures for curing mass concrete shall include such insulating and cooling techniques as are required to limit the temperature differential between the warmest and the coolest parts of a hydrating section to no more than 45°F (25°C). Describe the methods to be employed for monitoring concrete temperatures.
  - 6. Procedures for placing, finishing, curing and protecting flat work concrete shall include procedures for protecting that concrete from drying and plastic shrinkage cracking during placing and finishing processes, include procedures for curing and technical literature for proposed equipment.
- L. As-Built Shop Drawings: In a format acceptable to each, and at the completion of the Work, provide to Owner, to Architect and to Structural Engineer, one complete digital set of all Shop Drawings (including field changes, Field Work Drawings, and the like), so as to provide as-built drawings of finished and completed Work under this Section.
- M. Governing Agencies: Provide all drawings, tests, inspections, reports, affidavits, manufacturer's certifications, certification of compliance with VOC limits, and other requirements and data to governing agencies having jurisdiction.

## 1.6 MEASUREMENTS AND TOLERANCES

### A. Measurements:

1. Field Measurements: Obtain all field measurements required for proper fabrication and installation of Work covered by this Section. Submit, prior to installation, all measurements indicating discrepancies from the Drawings. Describe in writing and, where applicable, by sketches proposed methods of correcting discrepancies. Measurements are the responsibility of Contractor.
2. Lay out each part of the Work in strict accordance with the Architectural, Structural, Mechanical, Electrical, Plumbing and all other Drawings and be responsible for correct location of same. Lay out from at least two pre-established benchmarks and axis lines, individually correct for length and bearing.

### B. Allowable Tolerances: Conform to the requirements listed below and as given in ACI 117, whichever is more stringent; provide more restrictive tolerances where required to meet job conditions and *Building Code*. Tolerances indicated shall apply to the full height of the building. Variations from grade and flatness of Work may be measured prior to removal of supporting formwork or shores and shall be taken as either plus or minus from a true line.

1. Level Alignment:
  - a) Elevation of top of slab-on-ground, 3/4 inch (20 mm).
2. Relative Alignment:
  - a) Stairs
    - i) Difference in height between adjacent risers, 1/8 inch (3 mm).
    - ii) Difference in width between adjacent treads, 1/4 inch (6 mm).
3. Sleeves and Openings: Variations of the sizes and locations of sleeves, openings and the like shall not exceed minus 1/4 inch (-6 mm) or plus 1 inch (+25 mm) from size and 1/2 inch (13 mm) from centerline locations given in accepted Shop Drawings.
4. Anchors and Inserts: Variations in the location of anchors shall not deviate more than 3/8 inch (10 mm) vertically nor 1/4 inch (6 mm) horizontally from positions shown in accepted Shop Drawings.
5. The thicknesses of slabs and walls shall not deviate from theoretical by more than the following:
  - a) for dimensions of  
12 inches (300 mm) or less.....+3/8 in.(+10 mm), -0 in.(-0 mm)
  - b) for dimensions of more than  
12 inches (300 mm) but not over  
36 inches (900 mm) .....+1/2 in.(+13 mm), -3/8 in.(-10 mm)
  - c) for dimensions over  
36 inches (900 mm) ..... +1 in.(+25 mm), -3/4 in.(-19 mm)
6. Wall forms shall be braced during the forming, concrete placement and curing stages so as to produce wall straightness and vertical alignment which does not deviate from theoretical position by more than specified tolerances.



## 1.7 TESTING AND INSPECTION

- A. Owner's Testing Agency: All Work is subject to Special Inspection as required by *Building Code*. Subject to acceptance by Architect, Owner will engage and pay for the services of an independent testing agency (Testing Agency) as outlined in Section 014000, Inspection and Testing. The selected Testing Agency will meet the requirements of ASTM E 329. Contractor alone is responsible for the achieving of the required level of quality, both in the shop and in the field. Testing Agency will rely heavily on reviewed Shop Drawings, as described earlier in this Specification, in its examination of as-constructed Work. Contractor shall not retain Owner's Testing Agency for its own Work but may, subject to acceptance, contract through Owner for such work.
- B. Responsibilities and Duties of Testing Agency: Testing Agency will perform the following functions, inspections and tests:
1. On instructions and at locations selected by Architect, Testing Agency may sample materials taken from the as-erected Work.
  2. Take steps to ascertain that concrete is proportioned and mixed in accordance with the requirements of the Drawings and this Specification.
  3. Maintain a presence at the project site during the placing of concrete.
  4. Examine formwork for general conformance with the requirements of this Specification.
  5. Examine as-placed reinforcing steel for general conformance with the requirements of the Drawings and of this Specification.
  6. Receive and review concrete batch/truck tickets at time of delivery and prior to discharging concrete. Review of batch tickets shall include the comparison of actual material and quantities batched to mix design target values.
  7. Monitor the methods of conveying concrete from the mixer to the point of placement in the Work.
  8. Make, perform and evaluate testing of concrete cylinders in accord with this Specification, with ASTM C 31 and ASTM C 39, and as provided in Section 01 40 00. Capping for concrete cylinders shall be in accordance with either ASTM C 617 (bonded caps) or ASTM C 1231 (unbonded caps).
    - a) For each class and strength of concrete take the minimum cylinders indicated below, for each day's work, but not less than for each 100 cubic yards (75 cubic meters) of concrete nor less than for each 4300 square feet (400 square meters) of surface area for slabs or walls. Cylinders shall be tested in the schedule listed below. Where 28 days cylinders fail to conform to the requirements of this Specification, cylinders will be held and tested at 56 days;

Cylinder Size	Total Cylinders	Cylinder Testing Schedule			
		@7	@28	@56	@90
		days	days	days	days
4" x 8"	7	1	3	3	0
6" x 12"	5	1	2	2	0

- b) Where, after sampling any third portion of a truck load, the elapsed time exceeds 30 minutes, a set of 5 test cylinders will be taken from each third of the load taken at intervals greater than 30 minutes;
- c) Monitor protection systems for test cylinders; and

- d) Identify all test cylinders as to placement date and location, concrete mix type and designation number, concrete batch ticket serial number, and other pertinent data.
- 9. Perform slump tests in accord with ASTM C 143.
  - a) Take one test at the beginning of each placement, both at the truck and at the point of discharge, one test at the taking of test cylinders and such other tests as are deemed appropriate by Testing Agency, by Construction Manager, or by Architect.
- 10. Perform air entrainment tests in accord with ASTM C 231 (ASTM C 173 for concrete with lightweight or high absorption aggregates).
  - a) Take one test at the beginning of each placement, one test at the taking of test cylinders and such other tests as are deemed appropriate by Testing Agency, by Construction Manager, or by Architect.
- 11. Determine the temperature of freshly mixed concrete on a random basis during concrete placement in accord with ASTM C 1064.
- 12. Perform drying shrinkage tests in accord with ASTM C 157 and with Part 2 of this Specification.
- 13. For self-consolidating concrete, perform filling, passing, and segregation-resistance workability tests in accord with ACI 237R and ACI 212.3R-16, Chapter 18, "Admixtures for Self-Consolidating Concrete". Testing personnel shall have been trained and/or had previous experience in the testing of self-consolidating concrete.
  - a) For each concrete truck, take one test minimum in accordance with ASTM C1611 including visual stability index and T50 measurements as outlined in Appendix X1 of ACI 237R. Where truck is redosed with HRWR or VMA after the first test, testing shall be repeated.
  - b) For the first concrete truck and every 25 cubic yards thereafter, take one test minimum in accordance with ASTM C1621. Where truck is redosed with HRWR or VMA after first test, testing shall be repeated.
  - c) For the first concrete truck and every 25 cubic yards thereafter, take one test in accordance with ASTM C1712.
- 14. Testing Agency may visit the batch plant as often as weekly, more or less often where directed. Each visit will involve one or more of the following operations:
  - a) Examine aggregates for grading, cleanliness, moisture content, and the like;
  - b) Examine plant operation and equipment such as stock piles, bunker loading, scales, mixer, cement, water and admixture dispensing;
  - c) Review proportioning of mix, particularly for free moisture and the like; and
  - d) Truck loading.
  - e) For self-consolidating concrete, testing agency should visit the batch plant before the first truck is batched and conduct the operations listed below.
    - i) Where moisture probes or meters are used with automatic mixing water adjustment systems, testing agency shall conduct a moisture confirmation test in accordance to ASTM C 70 or C 566. Samples shall be taken as close as possible to the area where the probe is located.
    - ii) Where moisture probes or meters are not used with automatic mixing water adjustment systems, testing agency shall determine the aggregate moisture content before the first truck is batched. Thereafter, the aggregate moisture content shall be determined once every 4 hours have elapsed after the first batch while self-consolidating concrete is being mixed.

15. Perform physical testing of mechanical connections for reinforcement. In accordance with ASTM A 370, record the failure mode (bar fracture, coupler fracture, bar pull-out, etc...), maximum stress at yield, maximum load, ultimate tensile strength, elongation at failure, modulus of elasticity, diameter and area of reinforcement, and other pertinent data.
16. Test floor slab finished surface for flatness and levelness in accord with ASTM E 1155 and with this Specification.
  - a) The Floor Flatness/Levelness Inspector shall be certified by the Face Companies of Norfolk, Virginia as being competent in F-Number measurement using the Dipstick Floor Profiler. This person shall have tested not less than 250,000 square feet (23,000 square meters) of floor surface using ASTM E 1155 and the F-number system.
  - b) Measure slab elevations with a device capable of measuring and recording slab elevation changes of 0.002 inches (50  $\mu$ m). Use Dipstick by Face Companies, F-meter by Allen Face & Company, or other accepted device.
  - c) Where the area of slab surface which falls within 24 inches (600 mm) of construction joints exceeds 25 percent of the slab surface, the entire surface shall be tested, including those areas within 24 inches (600 mm) of construction joints.
  - d) Complete testing within 24 hours of placement and before shores are removed, and submit results, including a key plan showing area tested, data sheets and all results required by ASTM E 1155, within 48 hours of placement. Identify clearly all defective areas. Submit to Owner, Architect and Contractor.
17. Maintain a copy of ACI 311.1R - ACI Manual of Concrete Inspection, ACI 311.4R - Guide for Concrete Inspection and ACI 311.5R - Batch Plant Inspection and Field Testing of Ready-Mixed Concrete.
18. All test reports indicating non-compliance shall be emailed immediately to all participants listed on the distribution list and the hard copy shall be sent on different colored paper.
19. Not less than monthly, provide a summary report in graphical format of all test data taken for the project separated by class of concrete for the following:
  - a) Compressive strength (also group by age of concrete at time of test);
  - b) Slump or spread; and
  - c) Water content (both as determined from batch tickets and from microwave tests)
20. Perform Special Inspection of post-installed anchors in accordance with the Building Code, Manufacturer's Printed Installation Instructions, approved independent testing report per ACI 355, Contract Documents and approved shop drawings. As a minimum, provide continuous inspection of adhesive anchors installed in horizontal, or upwardly inclined orientations, supporting tension loads; and periodic inspection of all other conditions of post-installed anchors. Special Inspectors shall be qualified (via experience, training, ACI/CRSI certification, etc.) with the installation and inspection of post-installed anchors. Special Inspections shall include but are not limited to the following:
  - a) Verify installer qualifications as required per the Contract Documents;
  - b) Verify anchor type, material, size, length, and condition;
  - c) Verify minimum concrete age, temperature, strength, and dry condition;
  - d) Verify drilling method, hole cleaning, preparation per Manufacturer's Printed Installation Instructions; and
  - e) Verify anchor position, setting, and installation method

- C. Authorizations: Owner's Testing Agency will not be authorized to:
1. Authorize or accept deviations or substitutions from the Contract Documents.
  2. Assume any of the responsibilities of Contractor; for example, Testing Agency may not advise formally or informally on any aspect of construction means, methods, techniques, sequences or procedures, or safety precautions and programs in connection with the Work.
  3. Accept Shop Drawings or samples.
  4. Approve or issue a Certificate of Payment, a Change Order, or issue verbal or written instructions which modify the Contract between Owner and Contractor.
- D. Responsibilities and Duties of Contractor:
1. Performance or waiving of inspection, testing or surveillance by Testing Agency for a given portion of the Work will not relieve Contractor from responsibility to conform strictly to the requirements of the Contract Documents.
  2. Notice: To facilitate and to assist testing and inspection, Contractor shall cooperate by providing proper notice of the initiation of Work. Provide 24 hours minimum notice of each concrete placement or other operation requiring plant or job site testing or inspection.
  3. Access to Documents, Facilities and Materials: Furnish one copy of each accepted Shop Drawing and of each mill test certificate to Testing Agency. Provide reasonable office, desk and file space at each location of the Work and at the site to allow Testing Agency to work conveniently with and to maintain project records and drawings. Provide authorized personnel convenient and free access to all parts, locations and areas of Work, including storage areas. Provide hoisting, turning and moving of materials and reasonable quantities of scaffolding, power, casual labor, and other provisions and assistance necessary to allow quality and effective inspection and testing of Work.
  4. Provide suitable and adequately sized storage and initial curing facilities for concrete test cylinders. Conform fully to the requirements of ASTM C 31. Provide all necessary job site facilities required to allow and assist Testing Agency to perform its tests and inspections in full conformance to all applicable standards, codes, and provisions of this Specification.
  5. Secure and deliver to Contractor's independent testing laboratory without additional cost to Owner, representative samples of each material or ingredient required to be tested and certified prior to submittal for acceptance.
  6. Reimburse Owner for the actual cost of all tests performed exclusively for the Contractor's convenience (such as job cured cylinders for early stripping of formwork) and for all tests and retests made necessary by initial nonconformance to Contract Documents.
  7. Cost of Owner's Tests by Testing Agency will be borne by Owner. However, where additional tests are deemed necessary by Construction Manager or by Architect on account of failure to pass tests, the cost of additional testing will be deducted from payments to Contractor so as to reduce the Contract price.

## 1.8 QUALITY ASSURANCE

- A. Source Quality Control: Contractor's material control procedures shall be effective and shall assure that all Work fulfills the requirements of the project as well as the applicable provisions of the Contract Documents. All materials shall be tested in accord with the requirements of *Building Code*, of Building Department, of governing authorities having jurisdiction and of this Specification.

- B. Shop and Construction Site Quality Control: Contractor shall maintain, on staff, sufficient office, field engineering, and field supervision staff to assure that all data and layout drawings for Work of other Sections is transmitted to detailers to allow proper detailing of holes, penetrations, chases, and the like and to assure proper execution of the Work in the field.
- C. Minimum Qualifications: Fabricator, installer and detailer of reinforcing steel shall each have experience with at least five buildings of the type of this work.
  - 1. The reinforcing steel detailing firms shall be subject to acceptance. Detailing firms shall demonstrate in-house quality control procedures to the satisfaction of Construction Manager and of Architect. Acceptance of reinforcing steel detailer is provisional and may be withdrawn where detailing is not of sufficient quality to meet project requirements.
- D. Concrete Strength: Evaluation and acceptance of concrete strength shall conform to the requirements of ACI 318. Where laboratory cured cylinder test results do not satisfy these requirements, Contractor shall make sufficient and appropriate changes to concrete proportions for the remaining Work in order to assure acceptable strength test results. Where required, Contractor shall provide also reshoring and additional curing of concrete slow in attaining design strength. Additionally, at its sole discretion, Construction Manager or Architect may permit or require core tests in accord with ASTM C 42. Load tests shall not be performed without Construction Manager's or Architect's specific concurrence, and then only after acceptance of comprehensive, detailed procedures prepared by, signed and sealed by Contractor's Professional Engineer, and submitted in writing.
  - 1. Core tests may be required of Contractor where:
    - a) the average of one or more sets of three consecutive strength tests falls below f'c;
    - b) one or more individual strength tests falls below f'c by more than 500 psi (3500 kPa);
    - c) strength tests of field-cured cylinders, accomplished at the designated age, fall more than 15 percent below strength tests of companion laboratory-cured cylinders;
    - d) samples of concrete for acceptance test cylinders are not representative of concrete in place in the structure.
  - 2. Perform all tests, and all corrective and restorative measures at no expense to Owner. Construction Manager and Architect shall be sole interpreter of the need for additional tests, and Construction Manager's and Architect's judgment shall be binding on Owner and Contractor alike.
  - 3. Laboratory cured cylinders shall not be used for evaluating either compressive strength or acceptable condition of concrete suspected of being frozen, or for determining strength of concrete for early stripping of formwork.
  - 4. Should core specimens be taken, Contractor shall plug all core holes solid with matching concrete or non-shrink grout as directed. All such plugging shall be Contractor's responsibility and shall be performed at no expense to Owner. All such work shall be subject to acceptance and to correction by Contractor, where not in conformance with the Contract Documents.
- E. Qualifications: Contractor shall determine, shall warrant and shall certify that producers, epoxy coating applicator, reinforcing steel detailer, fabricator and installer, formwork constructor, concrete placer, finisher and all others involved in the Work, along with their personnel, are experienced, qualified and adequately staffed to undertake the specific Work required under this Section.

- F. Post-Installed Anchors shall be installed by workers with experience and training with installing the specified anchors. Installation of adhesive anchors in horizontal or upwardly inclined orientations supporting tension load shall be performed by installers certified through the ACI/CRSI adhesive anchor installer certification program, or approved equivalent.
- G. Documentation of Contract Conformance: Perform quality control functions required to achieve and to document that Work conforms to the Contract Documents. Provide access to Contractor's quality control documents and reports upon request. Provide reasonable numbers of copies of specific quality control reports on request.
- H. Purchase Orders: Each purchase order shall identify the end use of the purchased material. Contractor shall ensure that manufacturer or vendor understands fully the intended use of the material in the Work.

## **1.9 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Original Containers: Materials shall be delivered to the site, ready for use, in the manufacturer's original and unopened containers and packaging, bearing original labels as to type of material, brand name, and manufacturer's name. Delivered materials shall be identical to accepted samples.
- B. Storage: Materials shall be stored under cover in dry, weathertight, adequately ventilated and clean locations off the ground. Storage methods shall also provide for free and rapid drainage of rainwater and shall prevent collection of water on or within stored materials. Post-installed anchors shall be stored in accordance with manufacturer's requirements.
- C. Protect reinforcing steel and mesh from scaling, oil, grease and distortion. Reinforcing steel and mesh that has rusted to the extent of scaling will be rejected and may be placed in the Work only after proper cleaning, and shall be subject to acceptance.
- D. Aggregates to be used in field mixed concrete or grout shall be stockpiled in separate bins or piles in a manner suitable to minimize segregation and contamination of aggregates. Field mixing is not encouraged and will be allowed only with specific written permission.
- E. Removal: Delivered materials which are damaged or otherwise not suitable for installation, shall be removed from the job site and replaced with acceptable materials.
  - 1. Construction Manager and Architect shall be the sole judge of the suitability of such materials and neither Owner nor Contractor may challenge Construction Manager's or Architect's decisions as to acceptability.
- F. Batch/Truck Tickets: Provide a copy of each batch ticket for each batch of concrete discharged and used in work. Batch tickets shall be submitted to Owner or Owner's inspection agency prior to discharging concrete. Contractor shall retain duplicate tickets until such time as Owner has received a Certificate of Occupancy. Tickets need indicate the following:
  - 1. Ready-mix batch plant name and location.
  - 2. Project identification number, name and location.
  - 3. Serial number of ticket.
  - 4. Truck number.
  - 5. Mix type and designation number.
  - 6. Date and time of first mixing of cement and aggregates.

7. Actual material and quantities batched, both at plant and site, including total free water and admixtures. Total free water includes free water on the aggregates, water in each admixture, water and ice.
8. Amount of concrete batched.
9. Signature of plant quality control supervisor and, if water and/or admixtures are added at the site, site quality control supervisor.

#### **1.10 JOB CONDITIONS**

- A. **Contractor's Responsibility:** Contractor shall be solely responsible for the correctness of dimensions and quantities and for the fitting to other Work; for Work to be confirmed and correlated at the site; for information pertaining to the fabrication procedure or to the means, methods, techniques, sequences and procedures of construction; and for the coordination of the Work of this Section with the Work of all other trades. The verification of the physical interrelationships of elements of the Work from Contract Documents and in the field is solely Contractor's responsibility. Review of Contractor's submissions does not relieve Contractor from these responsibilities.
- B. **Contractor's Coordination:** Contractor shall coordinate and schedule the Work of this Section with the Work of other Sections of this Specification in order to optimize quality and to avoid delay in overall job progress.
- C. **Rejection of Work:** Testing Agency may inspect and test materials at the source before shipment as well as at the site before, during or after installation in the Work. Construction Manager and Architect reserve the right, at any time before final acceptance of the completed Work, to reject material not conforming with specified requirements, regardless of previous tests, inspections, acceptances, or inclusion in certificates of payment.
- D. **Provisions for Other Work:** The Work under this Section shall include required cutting, forming, reinforcing steel and all else required for the passing through and attachment of other Work.

#### **1.11 DEFICIENT WORK**

- A. **Repairing, Patching, Cleaning:** Contractor shall correct all Deficiencies in the Work of this Specification including areas where Testing Agency reports, or Construction Manager's or Architect's rejections have indicated that Work is not in full compliance with the Contract Documents. Perform, at no expense to Owner, all additional tests that Construction Manager or Architect deems necessary to reconfirm noncompliance of the original Work and perform, at no expense to Owner, all tests and inspections which may be necessary to show compliance of corrected Work.
- B. **Defective and Nonconforming Work:** Defective Work, unsuitable Work, or Work otherwise failing to conform to the Contract Documents shall be made good by Contractor at no change in the amount of or the time of the Contract. Contractor shall prepare appropriate details and procedures for bringing such Work into conformance with the Contract Documents and shall submit such details and procedures for acceptance. Corrective Work, including materials, shall conform strictly to accepted details and procedures. Nonconforming Work may be rejected at any time, regardless of prior acceptance in Shop Drawings, prior inspection, inclusion in inspection or test reports, or inclusion in certificates of payment.

- C. Deficiencies: Where Work exhibits any one or more of the following deficiencies, or where Work otherwise fails to conform to the requirements of the Contract Documents or to the requirements of *Building Code*, for any reason or combination of reasons, such Work shall be considered Deficient and not in conformance with the requirements of the Contract:
1. Low cylinder strength at 28 days, as defined by this Specification.
  2. Excessive or deficient water, air, cement, admixture, or any other material.
  3. Slump and slump-flow not in accord with this Specification.
  4. Unauthorized addition of water.
  5. Spalling, honeycombing or the like.
  6. Unauthorized cutting, chopping, construction joints, cold joints and so forth.
  7. Workmanship not in accord with the Drawings, with this Specification, with accepted samples, or with referenced codes or standards.
  8. Cracking, surface defects, or improper consolidation.
  9. Exceedance of tolerances, lack of alignment, and incorrect forming.
  10. Floor flatness/levelness F-numbers (either FF, FL or both) which measure less than specified minimum values.
  11. Evidence of freezing, improper curing and the like.
  12. Contact with aluminum or with aluminum alloys except where specifically permitted under this Specification.
  13. Post-installed anchors not set in accordance with Manufacturer's Printed Installation Instructions, adhesive anchors not set with insufficient adhesive (no overfill visible).
  14. Use of non-conforming materials or systems.
- D. Replacement or Repair: Where Construction Manager or Architect, at its sole discretion, finds any of the above deficiencies or other Work not in accord with the requirements of the Contract Documents, Construction Manager or Architect may order that the affected Work be replaced or repaired at Contractor's expense.
1. Contractor shall reimburse Owner for the actual amount of the fees of Testing Agency for the reinspection and the retesting of Work deemed defective by Construction Manager or by Architect.
- E. Cost: The cost of all other activities and procedures associated with defective Work shall be paid by Contractor.

## 1.12 PROFESSIONAL FEES AND COSTS

- A. Scope: Contractor shall compensate Architect, Structural Engineer and Architect's other consultants for services incurred because of Contractor-proposed deviations (including substitutions), extra submittals of Shop Drawings, deficient and defective Work and the like. Compensation will be at the rates given in the standard time-and-expense billing policy of the firm. Architect will notify Owner, Construction Manager and Contractor prior to the commencement of services associated with each item under this Article.
- B. Substitutions and Deviations: Contractor-proposed Substitutions and Deviations will be evaluated and reviewed where requested by Contractor.
- C. Shop Drawings: The review of the first and the second submittals of each Shop Drawing are normal services, but the review of the third and all subsequent submittals of each Shop Drawing will be considered an extra service and subject to the compensation provisions of this Article.



- D. Deficient Work: The evaluation, review and design and all other activities associated with Deficient Work are subject to the compensation provisions of this Article.
- E. Expediting: Where Contractor requests special handling of submittals, such costs are subject to the compensation provisions of this Article.

## PART 2 - PRODUCTS

### 2.1 CONCRETE MIXTURES

- A. Contractor Furnished Mix Designs: For each type and strength of concrete mixture and grout mixture required in the Work, Contractor shall submit for Architect's acceptance a mix design. Each mix design shall conform to the applicable provisions of this Specification and *Building Code*. Mix designs shall be established by Contractor's Professional Engineer licensed in the project's jurisdiction on the basis of field experience and or trial mixes prepared by Contractor and both monitored and tested by an independent testing laboratory retained and paid by Contractor. Mix designs in current use, documented by current test reports, may be submitted for acceptance in accord with ACI 301. All mix designs shall be submitted on the Mix Design Submittal Form included in this specification. This form is available electronically for Contractor's use.
1. Contractor shall be fully responsible for conformance to all mix design and control provisions of this Specification and for the strength, consistency, and handling of concrete. Concrete supplier, and admixture manufacturer(s) shall state and certify that the proposed concrete mixes and placing procedures will produce the strengths, finishes, densities and like qualities required by this Specification.
  2. Mix designs may be adjusted by Contractor to suit minor variability of materials, job conditions, weather, test results and other data, subject to acceptance and provided there is no change in the amount of the Contract; laboratory data for revised mix designs shall be submitted and accepted prior to use in the Work.
  3. Contractor shall pay all costs associated with preparing, testing, documenting and submitting design mixes for each concrete mix design used in the Work.
  4. Contractor shall provide notification of the time and location where each trial mix will be prepared and/or tested.
- B. Concrete Mix Requirements: Proportions for each mix shall provide for homogeneous, cohesive, workable and dense concrete, suitable in all respects for its intended purpose. Concrete mixes shall be selected to provide for requirements not less than those required by Table 2.1-1. All concrete shall have a maximum shrinkage of 0.04% at 28 days, unless otherwise noted, when tested in accordance with ASTM C157, 7-day moist cure.

TABLE 2.1-1

Nominal Strength f'c @ 28 days	Type of Concrete	Minimum Cementitious Content	Maximum Water- Cementitious Material Ratio
psi (MPa) Note 1		Lbs. Per CY (Kg per CM) Note 2	Note 3
Structural Concrete			
5,000 (34)	normal weight	635(377)	0.40
4000 (28)	lightweight	560 (356)	Note 4
Note 1:	f'c in accord with ACI 318 Articles 5.3.2 and 5.3.3.		
Note 2:	Minimum cementitious means total weight of cementitious material as permitted by this Specification (cement, slag, fly ash, and silica fume).		
Note 3:	Maximum water-cementitious material ratio will be reviewed for conformance to ACI 318 paragraph 5.3.3.2 (f). Field documented mix designs shall be responsive to this requirement.		
Note 4:	Maximum water content, minimum cement content and maximum allowable slump shall be those reported in the accepted mix design		

1. Each mix shall be proportioned to fulfill the water-cementitious material ratio at the maximum permitted slump. Self-consolidating concrete mixes shall be proportioned to fulfill the required workability criteria range and the water-cementitious material ratio and shall be established on the basis of full scale testing at the plant or site as well as trial mixes and mock-ups. In designing the mix, the size and the form of the structure, the dimension and density of reinforcement and cover should be taken in consideration.
  2. Contractor may use fly ash or other pozzolans to replace not more than 30% by weight, pound for pound, of required cement. Contractor may use slag to replace not more than 40% by weight, pound for pound, of required cement. Fly ash or slag may not be used to substitute for cement conforming to ASTM C 595, (i.e., for pozzolan modified cement). Silica fume may be used to replace not more than 10% by weight, pound for pound of required cement.
  3. Use admixtures as required by this Specification and as recommended by admixture manufacturer for the specific climatic conditions at the time of placement.
  4. Slump of less than 3 inch (75 mm) at point of discharge will not be permitted except where allowed specifically in this Specification.
  5. Slab on ground and topping slab concrete and built-up slab shall be macro synthetic fiber reinforced concrete. Minimum dosage shall be 4 lbs/cy unless otherwise noted.
- C. Air-Entrainment: Concrete shall be air-entrained in accord with Table 2.1-2 except that entrained air is not required for concrete for footings, interior slabs on ground to receive steel troweled finish, where such concrete will not be subject to freeze/thaw. Lightweight concrete shall be air-entrained in accordance with Table 2.1-2.

TABLE 2.1-2

TOTAL AIR CONTENT*		
Maximum Aggregate Size No.**	Maximum Nominal Size	Required Air Content (Percent)
# 467	1-1/2 (38 mm)	4.5 ± 1.5
# 57	1 (25 mm)	5.0 ± 1.5
# 67	3/4 (19 mm)	6.0 ± 1.5
# 7	1/2 (13 mm)	7.0 ± 1.5
# 8	3/8 (10 mm)	8.0 ± 2.0
* Interior slabs on ground, to receive steel troweled finish, shall have an air content not to exceed 2.0% ± 1%. No air entraining admixture permitted.		
** Size designations per ASTM C 33 or C 330.		

- D. Slump and Slump-Flow: Concrete that is not self-consolidating shall be proportioned and produced to provide slump, at the point of delivery into the work, as tabulated in Table 2.1-3. A tolerance of not more than 1 inch (25 mm) additional will be allowed for one batch within each five consecutive batches of each mix design.

TABLE 2.1-3

Type of Concrete	Maximum Slump inches *
Normal Weight	4 (100 mm)
Lightweight	4 (100 mm)
Slab on Ground	4 (100 mm)
Topping Slab	3 (75 mm)
Pumped	Note 1
Ramps and Sloping Surfaces	3 (75 mm)
* Increased slump may only be achieved by the used of the specified HRWR admixture.	
Note 1: All pumped concrete shall contain the specified HRWR admixture. Slump loss shall not be more than 2" from the pump to the point of deposit.	

1. Self-Consolidating Concrete Slump-Flow and Workability: Self-consolidating concrete shall be proportioned and produced to provide a slump flow from 22 inches (560 mm) to 30 inches (760 mm). Actual slump-flow and other workability test criteria shall be determined based on the requirements of the particular self-consolidating concrete application using trial mixes and full-scale test placements on site in accordance with ACI 237R, Self-Consolidating Concrete and other applicable standards.
- E. Water-Reducing Admixture shall be incorporated into all concrete (not required for mixes designed for superplasticized and self-consolidating concrete) at a minimum dosage of 3.5 fluid ounces per CWT (230 cm<sup>3</sup>/100 kg) of cement, in strict conformance with manufacturer's directions. Contractor shall consult with admixture manufacturer and shall propose increased dosage rates as appropriate to achieve optimum workability, cohesiveness and uniformity of concrete mixtures as placed in the Work.
1. Use non-corrosive, accelerating admixture in concrete slabs and in other thin concrete work where concrete is placed at ambient temperatures below 50°F (10°C).
- F. Superplasticized (HRWR) Concrete: Use in all pumped concrete and concrete with a water/cementitious ratio below 0.50 and in all locations where required to meet the requirements of the contract documents. Prepare with a high-range, water-reducing admixture (HRWR). Contractor's mix design shall also include written descriptions of Contractor's methods for mixing, placing and conveying concrete and shall also include design procedures to be used for the formwork.
1. HRWR mixes may be prepared to provide concrete with 9-inch (225 mm) maximum slump and intended slump of 8.0 +1 inch (200±25 mm) in lieu of the slump maximums specified herein, while adhering to the water-cementitious material ratio maximums specified. Alternatively, HRWR admixture may be used to provide concrete mixtures conforming to the specified maximum slump and water-cementitious material ratio values.
  2. HRWR admixtures shall be incorporated into the concrete mixtures at the batch plant or in the field through an approved dispensing unit. Water content of this concrete will be verified on the job site by use of the specified microwave test.
  3. Self-consolidating concrete shall always use a high-range, water-reducing admixture.
- G. Self-Consolidating Concrete shall be proportioned in accordance with ACI 237 and shall be subjected to trial mixes and placements. Self-consolidating concrete mixes shall include high-range, water-reducing (HRWR) and viscosity modifying (VMA) admixtures. In addition to the mix design submission requirements for normal concrete, self-consolidating concrete mixtures shall include:
1. Slump-flow, visual stability index, and T50 test results in accordance with ASTM C 1611. The slump-flow should meet the value tabulated in Table 2.1-3.2. The visual stability index should be 0.
  2. Passing ability test results in accordance with ASTM C 1621. Acceptable passing ability is where the J-ring test is within 2" of the slump-flow test, unless more stringent criteria apply.
  3. Stability test results in accord with ASTM C 1712. Acceptable penetration depth is less than ½".
  4. The level of slump flow or water content at which the mixture becomes unstable shall be determined and reported. Successive amounts of high range water reducing admixture or water shall be added to the trial mix and slump flow, visual stability index and T50 shall be measured. The level of slump flow or water content at which the mix becomes unstable shall be submitted.

5. Due to the sensitivity of self-consolidating concrete to changes in batching quantities, resiliency tests must be conducted and submitted for each design mix to ensure robustness of the mix within allowable lab tolerances. The strength and workability tests results for these resiliency tests shall fall within allowable tolerances. Tests shall include at a minimum:
  - a) One batch test where the powder content of the design mix is increased 2% and the water content is decreased 2%.
  - b) One batch test where the powder content of the design mix is decreased 2% and water content is increased 2%.
- H. Drying Shrinkage Limitations: All concrete placed above grade, except footings, shall comply with the following drying shrinkage requirements:
  1. Prior to placement of concrete, a trial batch of mix designs requiring shrinkage control shall be prepared using aggregates, cement and admixtures proposed for each class. From each trial batch, at least 3 specimens for determining the Drying Shrinkage shall be prepared in addition to 6 compression test specimens.
  2. The Drying Shrinkage specimens shall be 4 x 4 x 11 inch (100 x 100 x 280 mm) prisms, fabricated, moist cured, air dried and measured in the manner provided in ASTM C 511 and as modified herein. Specimens shall be air dried after moist curing for 7 days and shall be measured at an age of 14, 21, 28, and 35 days. The effective gauge length of the specimens shall be 10 inches (254 mm).
  3. Compression test specimens shall be fabricated, cured and tested in accordance with ASTM C 192. Three specimens shall be tested at an age of 7 days and three at the age of 28 days.
  4. During construction, Drying Shrinkage specimens of each shrinkage class of concrete will be taken to insure continued compliance with these Specifications. For each shrinkage class of concrete, at least one set of three specimens will be taken from each 1000 cubic yards (765 cubic meters) of concrete placed, but in no case less than three sets of specimens (i.e., nine specimens) will be taken for each class.
  5. The average Drying Shrinkage of the laboratory test specimens after 28 days of drying shall not exceed 0.040 percent or 0.020 percent where noted in the Contract Documents. Considering the variations in concrete properties and in testing, a tolerance of 30 percent in the above figure will be accepted for field cast specimens.
- I. Water-Cementitious Material Ratio: Calculate water-cementitious material ratio by dividing the weight of total free water (including water found in each admixture) in the concrete, per unit volume, by the number of pounds of cementitious material per unit volume. Total free water shall be taken as the total free water content of the mix when proportioned to produce the maximum allowable slump. Cementitious material is defined as cement, silica fume, fly ash and other natural pozzolans, and blast furnace slag. Water-cementitious material ratio shall be the decimal rounded to two significant figures obtained by dividing the total free water weight per cubic yard (meter) by the total weight of cementitious material per cubic yard (meter).
- J. Lightweight Concrete shall be measured in accordance with ASTM C 567, shall provide an air-dry unit weight of not less than 110 pcf (1760 kg/cubic meter) nor more than 115 pcf (1840 kg/cubic meter). All measurements shall be taken at points of discharge into the Work. Shrinkage shall not exceed 0.03 percent at 28 days when measured in accord with ASTM C 157.
- K. Cement Grout shall be composed of 1 part Portland cement and 3 parts fine aggregate, by volume, with minimum water to produce a stiff, but workable mix.

- L. Source Changes: Should the source of an ingredient change, for any of the concrete products specified herein, Contractor shall redesign the affected mix and shall resubmit, all prior to incorporating such material into the Work.
- M. Test Report Requirements: Contractor's test reports and Testing Agency test reports shall be prepared in a format as given in this Specification.
  - 1. Mixes shall be designated by a number (Mix No. 1, Mix No. 2,...etc).
  - 2. Individual samplings of a particular mix shall be designated by a number, with the first sample given the number 100 (Sampling 100, Sampling 101,...etc).
  - 3. Test cylinder numbers shall be provided using the sample number and a letter (102A, 102B,...etc).
  - 4. Contractor's Professional Engineer licensed in the project's jurisdiction shall review and shall sign each concrete test cylinder report indicating that the test shows conformance with the requirements of the Contract Documents.
  - 5. Deviations from project requirements shall be identified clearly by circling non-conforming data and by overprinting in 1/2 inch (13 mm) high red letters "NON-CONFORMING."
  - 6. For self-consolidating concrete mixes, provide, in addition, all workability test criteria reports attached to this Specification format.

SPACE FOR LABORATORY LETTERHEAD

REPORT OF CONCRETE COMPRESSIVE STRENGTH TESTS  
NEW YORK CITY POLICE MEMORIAL EXPANSION

FIELD DATA: Date: \_\_\_\_\_ Time: \_\_\_\_\_ Normal Wt. ( ) Lightweight ( )

Contractor: \_\_\_\_\_ Placement \_\_\_\_\_  
Concrete Supplier: \_\_\_\_\_ Locations \_\_\_\_\_

Conveyance Method:  
Bucket( ) Pump( ) Chute( ) Buggy( ) Tremie( ) Other \_\_\_\_\_

MIX NUMBER: \_\_\_\_\_ Cylinder Field Cure Data \_\_\_\_\_ Technician's Name: \_\_\_\_\_  
Slump, inches \_\_\_\_\_ Time, days \_\_\_\_\_  
Air Content, % \_\_\_\_\_ Min Temp, °F \_\_\_\_\_ Tests by: \_\_\_\_\_  
Concrete Temp, °F \_\_\_\_\_ Max Temp, °F \_\_\_\_\_  
Ambient Temp, °F \_\_\_\_\_ Curing Box ( ) \_\_\_\_\_ Cylinders by: \_\_\_\_\_  
Fresh Unit Wt, pcf \_\_\_\_\_ Other \_\_\_\_\_

MIX PROPORTIONS:		Batch Quantities Per Cubic Yard	Materials and Sources
Cement	(lb)	_____	_____
Water - Batched	(gal)	_____	_____
Water - Added	(gal)	_____	_____
Fine Aggregate	(lb)	_____	_____
Coarse Agg.	(lb)	_____	_____
Admixture	(fl. oz)	_____	_____
Admixture	(fl. oz)	_____	_____
Fly Ash or Slag	(lb)	_____	_____
Silica Fume	(lb)	_____	_____
Chloride Ion	(%by wt.of cem)	_____	_____
Macro Synthetic Fibers	(lb/cy)	_____	_____

TEST RESULTS:					Remarks
Cylinder Number	Cylinder Weight	Age (Days)	Comp. Strength (psi)	Split Strength (psi)	
Specified:					

For lightweight concrete: \_\_\_\_\_ P.E. \_\_\_\_\_  
Air-dry weight per ASTM C 567 \_\_\_\_\_ Pcf. Seal and Signature



## 2.2 CONCRETE INGREDIENTS

- A. Cement: Provide an accepted, single source, standard brand Portland cement, conforming to ANSI/ASTM C 150, Type I, II or III or ANSI/ASTM C 595, Type IP. Cement shall be from a single domestic source.
1. Use Type I or Type II cement except where another cement is herein specified and except where permitted.
  2. High-early strength, Type III, or other special cement, may be used in the Work only where permitted. The specified non-chloride admixture may be used.
- B. Aggregate: Fine and coarse aggregates shall be regarded as separate ingredients. All aggregates shall meet the requirements listed below except that, where accepted by *Building Code*, non-conforming aggregates will be considered in accordance with the provisions of the Contract Documents.
1. Coarse Aggregate: shall conform to ANSI/ASTM C 33, and shall consist exclusively of sound and durable gravel or crushed stone, having clean, uncoated, hard and strong particles, free from soft, thin, elongated or laminated particles, and from deleterious materials such as alkali, organic, soft or expansive matter. ASTM Grade Size #67 (19 to 4.8 mm), #57 (25 to 4.8 mm) or #467 (37 to 4.8 mm). Aggregates in excess of 3/4 inch (19 mm) shall not be used except in footings and pile caps, except where required specifically by this Specification or by the Drawings and except where accepted in writing. Water absorption of dry aggregate shall not exceed 1 percent.
  2. Lightweight Coarse Aggregate: shall be a rotary kiln product of expanded shale or slate, conforming to ANSI/ASTM C 330, ASTM Grade Size #67 (19 to 4.8 mm) or ASTM Grade Size #8 (9.5 to 2.4 mm), and shall conform also to all requirements for Coarse Aggregate.
  3. Fine Aggregate: shall conform to ANSI/ASTM C 33, consisting exclusively of natural sand or crushed stone screenings, having clean, uncoated, hard and strong particles, free from clay, shale, lumps, salt and flaky particles, and from deleterious materials such as alkali, organic, soft or expansive matter. Fine aggregate shall be evenly graded from fine to coarse, with a fineness modulus not less than 2.30, nor more than 3.10.
  4. Combined aggregate gradation for slabs and other designated concrete shall be 8% - 18 % for large top size aggregates (1 1/2 in.) or 8%-22% for smaller top size aggregates (1 in. or 3/4 in.) retained on each sieve below the top size and above the No. 100.
  5. Concrete Topping: Coarse aggregate shall conform to ANSI/ASTM C 33 or C 330 as appropriate, ASTM Grade Size #7 or #8 (12 mm to 4.8 mm or 9.5 mm to 2.4 mm) and shall conform also to all requirements for Coarse Aggregate given above. Fine aggregate shall conform to all requirements for Fine Aggregate as given above.
  6. Cement Finish: Aggregates shall be graded from 1/8 (3 mm) to 3/8 inches (10 mm), with not less than 95 percent of aggregate weight passing the 3/8 inch (10 mm) sieve.
  7. Cleanliness of Aggregate: Aggregates shall have a minimum C.V. (cleanliness value) and a minimum S.E. (sand equivalent) of 75.0. Three samples shall be taken from the weight hopper and the average of the results of the three individual tests shall be the accepted value. Tests shall be taken throughout the course of the Work. Deviation from the accepted value will be the cause of rejections of the material.
- C. Water: Mixing water for concrete shall be clean, fresh, free from injurious amounts of oil, acid, alkalis, salts, organic materials and other deleterious materials and shall conform to ASTM C1602. Antifreeze agents may not be used unless accepted in writing. In case of uncertainty, water shall be potable.

- D. Admixtures listed below by name and by brand are accepted for use in the Work. Other admixtures will be considered for use but are subject to acceptance. Admixtures contributing to chloride, fluoride, sulfide or nitrate ions, or to other substances detrimental to the ingredients of the concrete or to reinforcing steel, will not be permitted in the Work.
1. Water-Reducing Admixture shall conform to ASTM C 494, Type A.
    - a) Pozzolith 322-N or Polyheed 997, by BASF.
    - b) WR-91, or Plastol Series, by Euclid Chemical Co.
    - c) Plastocrete 161 or Sikament HP, by Sika Corp.
    - d) WRDA with HYCOL or Daracem 55, by W.R. Grace Construction Products.
    - e) Other accepted admixture.
  2. Retarding Admixture shall conform to ASTM C 494, Type B.
    - a) Delvo ESC, by BASF.
    - b) Eucon Retarder 100, by Euclid Chemical Co.
    - c) Other accepted admixture.
  3. Non-corrosive, Non-Chloride Accelerator: The admixture shall conform to ASTM C 494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Type C Admixtures are:
    - a) Pozzutec 20+, by BASF.
    - b) Accelguard 80, 90 or NCA by Euclid Chemical Co.
    - c) Sika Rapid-1, by Sika Corp.
    - d) Polarsset, by W.R. Grace Construction Products.
    - e) Other accepted admixture.
  4. Water-Reducing, Retarding Admixture shall conform to ASTM C 494, Type D.
    - a) Pozzolith 100 XR or 300 R, by BASF.
    - b) Eucon Retarder 75 or 100, by Euclid Chemical Co.
    - c) Plastiment or Plastocrete 161MR, by Sika Corp.
    - d) Daratard 17, by W.R. Grace Construction Products.
    - e) Other accepted admixture.
  5. Non-Corrosive, Water-Reducing, Accelerating Admixture shall conform to ASTM C 494, Type E.
    - a) Polyheed FC100, by BASF.
    - b) Accelguard 80, 90, or NCA, by Euclid Chemical Co.
    - c) Plastocrete 161FL, by Sika Corp.
    - d) Other accepted admixture.
  6. High-Range Water-Reducing Admixture (Superplasticizer) shall conform to ASTM C 494, Type F.
    - a) Rheobuild 1000, by BASF.
    - b) Eucon 37/1037, or Plastol Series by Euclid Chemical Co.
    - c) Sika ViscoCrete 2100, by Sika Corp.
    - d) ADVA 140M, by W.R. Grace Construction Products.
    - e) Other accepted admixture.

7. High-Range Water Reducing, Retarding Admixture (Superplasticizer) shall conform to ASTM C 494, Type G.
    - a) Eucon Retarder 75, by Euclid Chemical Co.
    - b) Daracem 100, by W.R. Grace Construction Products.
    - c) Other accepted admixture.
  8. Air-Entraining Admixture shall conform to ANSI/ASTM C 260.
    - a) Micro-Air or MB AE 90, by BASF.
    - b) AEA-92 or Air Mix, by Euclid Chemical Co.
    - c) Sika AER or Sika AEA-15, by Sika Corp.
    - d) Daravair 1000 or Darex II AEA, by W.R. Grace Construction Products.
    - e) Other accepted admixture.
  9. Prohibited Admixtures: Calcium chloride thiocyanates and admixtures containing more than 0.05% chloride ions are not permitted.
  10. Calcium Nitrite Based Corrosion Inhibitor Admixture shall contain a minimum of 30 percent of calcium nitrite by weight.
    - a. Rheocrete 222+, by BASF.
    - b. Eucon CIA, by Euclid Chemical Co.
    - c. DCI S, by W.R. Grace Construction Products.
    - d. Other accepted admixture.
  11. Shrinkage-Reducing Admixture.
    - a. Tetraguard AS 20, by BASF.<http://www.masterbuilders.com/>
    - b. Eucon SRA or Conex, by Euclid Chemical Co.
    - c. Sika Control 40, by Sika Corp.
    - d. Eclipse, by W.R. Grace Construction Products.
    - e. Other accepted admixture.
  12. Viscosity Modifying Admixture for Self-Consolidating Concrete.
    - a) Rheomac VMA 362 and 450, by BASF.
    - a) Eucon DS or Eucon Stasis, by Euclid Chemical Co
    - b) Sika Stabilizer 300 SCC, by Sika Corp.
    - c) V-Mar 3, by W.R. Grace Construction Products.
    - d) Other accepted admixture.
- E. Chloride Ion: It is understood that certain admixtures do contain a concentration of calcium chloride. Design mix shall contain a summary of total calcium chloride concentration, including the content of admixtures. Total concentration in excess of that listed in ACI 318 Table 4.4.1 will be rejected without further review. Concentrations less than those listed in ACI 318 Table 4.4.1 may be accepted where, in the sole opinion of Construction Manager or of Architect, such concentration will not be detrimental to the Work. The amount of calcium chloride shall be determined by the method described in ASTM C 1218.
- F. Fly Ash shall conform to ASTM C 618, Class C or F except that loss on ignition shall not exceed 3 percent and maximum percentage retained on the #325 (45 µm) sieve shall not exceed 20 percent. Fly ash shall be from a single, accepted source.
- G. Natural Pozzolans, such as calcined clay, calcined shale, and metakaolin, shall conform to ASTM C618, Class N.

- H. Silica Fume (microsilica) shall contain a silicon dioxide ( $\text{SiO}_2$ ) content not less than 92%, shall be of either dry densified or slurried form, conforming to ASTM C 1240, and shall come from a single, accepted source:
  - 1. Rheomac SF 100, by BASF.
  - 2. Eucon MSA, by Euclid Chemical Co.
  - 3. Sikacrete 950DP, by Sika Corp.
  - 4. Force 10,000D, by W.R. Grace Construction Products.
  - 5. Other accepted microsilica based admixture.
- I. Blast Furnace Slag shall conform to ASTM C 989, Grade 120.
- J. Fibrous Reinforcement shall conform to ASTM C 1116 Type III.
  - 1. Synthetic Macro-Fibers: Structural fibers shall be a coarse monofilament, self-fibrillating, polypropylene/ polyethylene blend in accordance with ASTM C1116, Paragraph 4.1.3, Type III. Structural fiber shall have a minimum tensile strength of 73 to 80 ksi and a minimum length of 1.5 inches. To be used for slabs-on-ground and topping slabs. .
    - a) Tuf-Strand SF, by Euclid Chemical Co.
    - b) Strux 90/40, by W.R. Grace Construction Products.
    - c) Other accepted fiber reinforcement.

## 2.3 FORMWORK MATERIALS

- A. Form Contact Faces:
  - 1. For Surfaces Not Exposed To View:
    - a) Lumber shall be stress grade lumber described and used in accord with the National Design Specification for Wood Construction. Lumber shall be dressed on three sides and ends for a tight fit.
    - b) Plywood for formwork shall be in accordance with U.S. Product Standard PS-1, Structural 1 "B-B (Concrete Form) Plyform", Exterior Grade, mill oiled and edge-sealed, not less than 9/16 inch (14 mm) thick. Field cut edges shall be resealed with a solvent-based sealant. Each piece shall bear the legible inspection trademark.
    - c) Chamfer Strips for outside corners in forms may be of wood, metal or PVC at Contractor's option. Rubber chamfer strips may be used only where not exposed to view.
    - d) For self-consolidating concrete formwork, care shall be taken to ensure the forms are water-tight.
  - 2. For Surfaces Exposed to View and for Multiple Reuse Applications:
    - a) Plywood for formwork shall be in accordance with U.S. Product Standard PS-1, Structural 1" B-B (Concrete Form) Plyform", Douglas Fir, Exterior Grade, High Density Overlay (HDO) thermo-set resin-impregnated, mill oiled and edge-sealed, not less than 9/16 inch (14 mm) thick. Field cut edges shall be resealed with a solvent-based sealant. Each piece shall bear the legible inspection trademark. Provide Pourform-HDO by Savona Specialty Plywood, or other accepted form.

3. Form Gaskets (for sealing form panel joints): Gaskets shall be closed cell, completely skinned, foam rubber or neoprene, with pressure sensitive paperbacked adhesive on surfaces to be bonded to forms. Gaskets shall be of sufficient thickness, widths, and compressibility for specific use.
  4. Reveal Formers and Reformers: Sealed (polyurethane) milled fir (dressed and sanded), for straight reveals; and or extruded or molded vinyl, rubber or neoprene of 75 Durometer hardness for special and circular profiles, as required. Reformers shall be reveal strips specified with gasket applied between reveal and concrete.
- B. Form Sealers and Release Agents shall be guaranteed by manufacturer to be non-grain raising, non-staining and to not impair the natural bond of paint, waterproofing and other surface coatings.
1. Form Sealer for Lumber Surfaces and Plywood Edges: Polyurethane, clear coating.
  2. Form Release Agents: Provide chemically reactive, non-staining, non-toxic, commercially blended form release agents that are compatible with material subsequently applied and free from deleterious effects on final concrete surfaces or applied coatings and finishes. Products containing castor oil shall not be used in the Work. Special care need be taken with self-consolidating concrete to ensure that the form release agent has been applied to clean, smooth forms in a uniform and appropriate thickness.
    - a) General Purpose Form Release Agents
      - i) Formshield Pure, by Euclid Chemical Co.
      - ii) Debond Form Coating, by L&M Construction Chemicals, Inc.
      - iii) Nox-Crete Form Coating 250, by Nox-Crete, Inc.
      - iv) Other where accepted.
- C. Form Ties:
1. For Surfaces Not Exposed to View: Ties shall be of standard manufacture, factory fabricated, designed specifically for use in concrete formwork. Non-fabricated wire and similar accessories shall not be used. Sizes shall be appropriate for the wall, beam, or other element formed. Ties shall be readily removable leaving no metal within 1 inch (25 mm) measured from the concrete surface and shall be free of lugs, cones, washers, or other devices that will leave a hole larger than 1 inch (25 mm). Use Williams Form Engineering Corp. or Dayton Superior coil ties, with cones or accepted snap ties with cones, except where ties of another design or manufacture are accepted.
- D. Other: Formwork materials not given herein or identified in Drawings shall be subject to acceptance.

## 2.4 REINFORCEMENT MATERIALS

- A. Reinforcing Bars, etc.: Except where more stringent requirements are given in the Drawings or required by *Building Code*, provide ASTM A 615, new billet steel, deformed. Rail, axle, or rerolled steel shall not be used.
1. Provide Grade 60 unless otherwise given in the Drawings or in this Specification.
  2. Steel wire shall conform to ASTM A 82, plain, cold-drawn steel.

- B. Tie Wire: 18 gauge (1310  $\mu$ m) or heavier, black annealed wire, conforming to ANSI/ASTM A 82. Tie wire in concrete at exposed surfaces shall be non-corrosive; stainless steel, monel, or plastic coated.
- C. Bolsters, Chairs, Spacers, and other devices for spacing supporting and fastening reinforcing bars and welded wire fabric:
  - 1. Accessories shall be all-plastic or shall be plastic coated metal. Metal may not extend closer than 1/8 inch (3 mm) to concrete surface. Plastic color shall match finished concrete color. Conform to CRSI requirements.
  - 2. Precast concrete blocks furnished for reinforcement support shall be produced specifically for intended purpose; brick, stone, wood and other materials will not be permitted. Precast concrete blocks three inches (75 mm) or larger shall have the same compressive strength as the structural concrete in which they are used. Precast blocks smaller than three inches (75 mm) shall be 6,000 psi (41 MPa) at time of use.
  - 3. For slabs-on-ground, use precast concrete blocks or supports with base plates or with horizontal runners at all locations where base materials will not properly support the legs of chairs.

## 2.5 MISCELLANEOUS MATERIALS

- A. Non-Shrink Grout shall be natural aggregate grout pre-mixed and bagged by manufacturer. Non-shrink grout shall conform to ASTM C 1107 Grade B or C when tested at a fluid consistency of less than 30 seconds per ASTM C 939 at temperature extremes of 40°F and 90°F (7°C and 32°C) and an extended working time of 30 minutes. The corresponding minimum compressive strength of the grout at 28 days, based on ASTM C 942, shall be 7500 psi. The grout shall exhibit no measurable bleed when tested in accordance with ASTM C 940.
  - 1. Sure-Grip High Performance Grout, by Dayton Superior.
  - 2. Hi-Flow Grout, by Euclid Chemical Co.
  - 3. Five Star Fluid Grout 100, by Five Star.
  - 4. Masterflow 928 Grout, by MBT Technologies and Repair.
  - 5. Other where accepted.
- B. Epoxy Grout shall be non-shrink, 100% solids, 3-component, moisture tolerant grout.
  - 1. E3-F, by Euclid Chemical Co.
  - 2. Five Star Epoxy Grout, by Five Star.
  - 3. Masterflow 648 CP, by MBT Technologies and Repair.
  - 4. Sikadur 42, by Sika Corp.
  - 5. Other where accepted.
- C. Bonding Admixture shall be Latex type, non-redispersable, modified sand cement mortar conforming to ASTM C 1059, Type II.
  - 1. Day-Chem Ad Bond, by Dayton Superior Corp.
  - 2. Flex-Con or SBR Latex, by Euclid Chemical Co.
  - 3. Everbond, by L&M Construction Chemicals, Inc.
  - 4. Strong Bond, or Sure Bond (EVA), by Symons Corp.
  - 5. Other where accepted.

- D. Epoxy Adhesive shall conform to ASTM C 881, and shall be a two-component, 100% solids material, suitable for use on both dry and wet surfaces. Acceptable materials:
1. Sure-Anchor Epoxy, by Dayton Superior Corp.
  2. Dural #452 Series or Duralprep AC, by Euclid Chemical Co.
  3. Concesive Standard Paste LVI, by MBT Technologies and Repair.
  4. Sikadur 32 Hi-Mod or Sikadur 32 Hi-Mod LPL, by Sika Corp.
  5. Rezi-Weld 1000, by W.R. Meadows, Inc.
  6. Other where accepted.
- E. Anti-Corrosive, Epoxy/Cementitious Adhesive: The adhesive shall be a water-based epoxy/cementitious compound for adhesion and corrosion protection of reinforcing members (20 hour maximum open time). Provide one of the following or approved equal:
1. Duralprep AC by Euclid Chemical Company.
  2. Armatec 110 by Sika Corporation.
- F. Polymer Repair Mortar: These patching mortars may be used when color match of the adjacent concrete is not required. Prior approval by the Structural Engineer is required.
1. Polyfast FS, by Dayton Superior.
  2. Thin Top Supreme or Concrete Top Supreme (horizontal repairs), Verticoat or Verticoat Supreme (vertical and overhead repair), by Euclid Chemical Co.
  3. Sikatop 121 & 122 (horizontal repair), Sikatop 123 (vertical and overhead repairs), by Sika Corp.
  4. Other where accepted.
- G. High Strength Flowing Repair Mortar for forming and pouring structural members, or large horizontal repairs, provide the flowable one-part, high strength microsilica modified repair mortar with 3/8" aggregate. The product shall achieve 9000 psi @ 28-days at a 9-inch slump.
1. Eurocrete, or Euco Speed MP (Cold Weather) by Euclid Chemical Co.
  2. Polyfast LPL, by Dayton Superior.
  3. Emaco S77 CI, by MBT Protection and Repair.
  4. Other where accepted.
- H. Post-Installed Mechanical Anchors shall be either expansion or undercut type. Where substitutions are requested, the alternate anchor shall be similar in type to that specified in the Contract Documents and be designed in accordance with substitution requirements.
1. Standard Wedge-Type Expansion Anchors:
    - a. Kwik Bolt 3 and TZ, by Hilti Corp.
    - b. Power-Stud+ SD1 and SD2, by Power Fasteners Inc.
    - c. Strong-Bolt 2, by Simpson Stront-Tie
    - d. Other where accepted
  2. Heavy-Duty Wedge-Type Expansion Anchors:
    - a. HSL 3 Heavy Duty Sleeve Anchor, by Hilti Corp.
    - b. Power-Bolt, by Powers Fasteners Inc.
    - c. Other where accepted
  3. Undercut Expansion Anchors:
    - a. HDA Undercut Anchor, by Hilti Corp.
    - b. Atomic+, by Powers Fasteners Inc.
    - c. Torq-Cut, by Simpson Strong-Tie

- d. Other where accepted
  - 4. Galvanizing shall conform to ASTM B 695, Class 50 or to ASTM B 633, SC1.
  - 5. Stainless steel for studs and washers shall conform to AISI Grade 304 or Grade 316 and to ASTM F 593, Group 1 or Group 2, Condition SH. Nuts shall be of stainless steel conforming to ASTM F 594, Group 1 or Group 2, Condition SH.
- I. Post-Installed Adhesive Anchors shall be either acrylic or epoxy, injectable type. Where substitutions are requested, the alternate adhesive shall be similar in type to that specified in the Contract Documents and be designed in accordance with substitution requirements.
- 1. Acrylic or Vinylester Adhesive:
    - a. HY200, by Hilti Corp.
    - b. AC100+ Gold, by Powers Fasteners Inc.
    - c. Other where accepted
  - 2. Epoxy Adhesive:
    - a. Hilti RE 500 V3, by Hilti Corp
    - b. PE1000+, by Powers Fasteners Inc.
    - c. SET-XP, by Simpson Strong-Tie
    - d. Other where accepted
  - 3. Galvanizing shall conform to ASTM B 695, Class 50 or to ASTM B 633, SC1.
  - 4. Stainless steel for studs and washers shall conform to AISI Grade 304 or Grade 316 and to ASTM F 593, Group 1 or Group 2, Condition SH. Nuts shall be of stainless steel conforming to ASTM F 594, Group 1 or Group 2, Condition SH
- J. Polyurethane Sealant shall be Eucolastic I by Euclid Chemical Co., Dymonic by Tremco, Inc., Sikaflex-1a by Sika Corp., or other accepted sealant. Sealant shall conform to ASTM C920. Color shall be accepted by Architect. Backer rod shall be as recommended by sealant manufacturer.
- K. Joint Filler:
- 1. Unless otherwise noted, use non-staining, non-extruding, compressible and resilient joint filler of sponge rubber conforming to ASTM D 1752, Type I. Joint fillers which contain or have been treated with oil, grease or bituminous materials are prohibited. Test joint fillers for compatibility with proposed primers and sealants.
  - 2. Acceptable preformed joint filler: FF-3 Sponge Rubber, by Progress Unlimited, Inc.; Cementone Sponge Rubber, by Tamms Industries; or other accepted filler.
  - 3. Provide compatible joint sealing compound.
- L. Cellular Polystyrene shall conform to ASTM C 578, Type IV or better and shall be sufficiently hard and dense and/or shall be sealed so as to preclude completely the dispersing of Styrofoam particles into the plastic concrete. Acceptable cellular polystyrene: Styrofoam Cavitymate Plus, by The Dow Chemical Co., or other acceptable cellular polystyrene.
- M. Bond Breaker shall be 4 mil (100  $\mu$ m) thick polyethylene sheet.
- N. Moisture-Retaining Cover Conforming to ASTM C171: A naturally colored, non-woven polypropylene fabric with a 4-mil non-perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Acceptable Moisture-Retaining Cover: Hydracure S-16 by PNA Construction or Transguard 4000 by Beef Industries.



- O. Crushed Stone:
1. Under slabs-on-ground shall consist of clean, hard, durable, natural rock, free of organic matter, rock dust and other contaminants, and shall be well graded within the requirements of ASTM C 33, Size #467.
    - a) Material conforming to AASHTO Specification M80 will be accepted for use in the Work.
  2. Bridging rock where required to span over softer areas of the underlying soils shall consist of a coarse granular mixture of rock fragments having a maximum particle size of 6 inches (150 mm). It is anticipated that quarry run or crusher run materials will be satisfactory. The material shall be well graded between the maximum and minimum sizes with no more than 15 percent passing the U.S. Standard Number 200 sieve (75  $\mu$ m).
- P. Compactible Fill under slabs-on-ground shall be composed of well graded gravel or crushed stone, 1½" maximum size. "Crusher run" material is satisfactory. Do not use sand except with prior approval of the Architect. Fill shall be free-draining, free from clay, shale, lumps, salt, organic matter, rock dust and other contaminants, and shall consist of hard, clean and durable particles.
- Q. Pachometer (reinforcing bar locator): Use James R-Meter by James Instruments or other accepted pachometer.

## 2.6 SURFACE TREATMENTS

- A. Clear Curing and Sealing Compound VOC Compliant, 350 g/l, shall be a liquid type membrane-forming curing compound, complying with ASTM C 1315, Type I, Class A, 25% solids content minimum. Moisture loss shall be not more than 0.40 kg/m<sup>2</sup> when applied at 300 sq. ft./gal. Compound shall be compatible with all subsequent finishes and toppings, shall chemically combine fully with the concrete in 30 days or less, shall leave no surface residue, and shall preclude secondary reactions within concrete as well as materials applied to the concrete surface. Manufacturer's certification is required. Subject to project requirements, provide one of the following products:
1. Super Diamond Clear VOX, by Euclid Chemical Co.
  2. Lumiseal WB Plus, by L&M Construction Chemicals, Inc.
  3. Kure 1315, by Sonneborn Products.
  4. Other where accepted.
- B. Dissipating/Non-residue Forming (Strippable) Curing Compound (VOC Compliant, 350 g/l) shall be a liquid membrane-forming compound conforming to ASTM C 309, Type 1 or 1-D that chemically breaks down and wears off after curing is complete. Install in strict accordance with the manufacturer's recommendations. Manufacturer's certification is required.
1. Kurez DR VOX, by Euclid Chemical Co.
  2. L&M Cure R, by L&M Construction Chemicals, Inc.
  3. Kure-N-Harden, by Sonneborn Products.
  4. 1100-Clear Series, by W. R. Meadows, Inc.
  5. Other where accepted.

- C. Evaporation Retarder/Finishing Aid:
1. Eucobar, by Euclid Chemical Co.
  2. E-Con, by L&M Construction Chemical, Inc.
  3. Confilm, by MBT Protection and Repair.
  4. SikaFilm, by Sika Corp.
  5. Other where accepted.
- D. Liquid Densifier/Sealer: The liquid densifier compound shall be a siliconate based sealer which penetrates concrete surfaces, increases abrasion resistance and provides a "low-sheen" surface that is easy to clean and eases the problem of tire mark removal. The compound need contain a minimum solids content of 20%, of which 50% is siliconate.
1. Euco Diamond Hard, by Euclid Chemical Co.
  2. Ashford Formula, by Curecrete Chemical Co., Inc.
  3. Seal Hard, by L & M Construction Chemicals, Inc.
- E. Waterproofing and Chloride Ion Screen: Silane water repellent and chloride ion shield shall contain not less than 40 percent solids and shall provide not less than 90 percent chloride ion screening capability when tested in accordance with NCHRP 244.
1. Weather Worker S-40 J-29 WB, by Dayton Superior.
  2. Euco-Guard VOX, by Euclid Chemical Co.
  3. Hydrozo Silane 40-VOC, by Hydrozo.
  4. Aquapel, by L & M Construction Chemicals, Inc.
  5. Masterseal SL 40 VOC, by MBT Protection and Repair.
  6. Other where accepted.
- F. Concrete Cleaning/Finishing Solution: General surface cleaner shall be a commercial concrete cleaner containing solvents, stain removers, detergents and a maximum of 2 percent chloride acid. Accepted cleaner: Light Duty Concrete Cleaner by ProSoCo, Inc., or other accepted compound.

## **PART 3 - EXECUTION**

### **3.1 CONTRACTOR'S INSPECTION**

- A. Examination of Field Conditions: Examine all surfaces, features and facilities to which Work must be attached or applied, abut or clear. Notify Construction Manager and Architect in writing of all conditions which are or will be detrimental to proper and expeditious installation of Work. Starting of Work shall represent acceptance by Contractor of surfaces and of conditions as suitable and correct for performing Work as specified.
- B. Field Measurements: Contractor shall verify, by measurements at the job site, all dimensions affecting the Work of this Section. Field dimensions at variance with those in accepted Shop Drawings shall be reported in writing by Contractor. Decisions regarding corrective measures shall be subject to acceptance and acceptance shall be obtained before starting fabrication of items affected. The starting of Work shall represent acceptance by Contractor of all dimensions affecting the Work of this Section as suitable and correct for the performing of all Work under this Section.

### **3.2 FORMWORK**

- A. Reference Standards: Formwork shall conform to ACI 347R, except where more stringent requirements are given in the Drawings or in this Specification.
- B. General: Contractor shall be solely responsible for the design, engineering, construction, completeness, safety and adequacy of all concrete formwork. Provide removable formwork for all concrete not indicated specifically to be formed by other means. Provide for anchorages and inserts, blocking, bulkheads, chamfers, keys and keyways, ledges, moldings, offsets, openings, recesses, reglets, screeds and all else to complete the Work.
  - 1. Formwork shall be designed and constructed to withstand all forces imposed upon the formwork including all construction dead and live loads, horizontal loads from equipment, wind and earthquake forces, and forces due to vibration of plastic concrete. Shoring shall be adequate in strength and in position so that loads of successive parts of the structure will be transmitted directly through the falsework without the creation of shearing or bending stresses in the concrete Work.
  - 2. Formwork shall be tight to prevent leakage of mortar from the concrete so as to provide concrete free of honeycombs, shall be of adequate rigidity and strength, and shall be adequately braced to produce true lines, free of bulges and unsightly depressions, to accurate elevations and correct alignments. Joints between form face edges shall be tight and strongly backed to provide joints that are flush and true. Provide inspection of all formwork for conformance with this Specification and with form drawing design, both prior to, during and after concreting.
  - 3. Fabricate for easy removal, without prying or hammering against concrete surfaces. Provide crush or working plates where stripping may damage concrete surfaces.
  - 4. Clean-Out and Access Panels: Provide readily removable and securely replaceable panels in column forms, wall forms, and other types of formwork as needed to permit ready access for cleaning formwork totally free from standing water, dust, dirt and other debris, allow inspection of condition of formwork, reinforcement, and concrete bonding surfaces, and as needed to allow proper access for concrete placement and vibration. Locate removable panels to minimize exposure to view, except where more exposed locations are accepted.
  - 5. Provide top forms at all inclined surfaces where slope is too steep to place concrete with bottom form only.

C. Self-Consolidating Concrete Formwork:

1. Self-consolidating Concrete: Due to the fluid nature of self-consolidating concrete, higher pressures than conventional concrete should be expected and accounted for in formwork design. Where noted in the contract documents that self-consolidating concrete shall be pumped from the bottom of the forms, consideration shall be given to the additional pressure on the formwork from pumping.
2. Store forms such that they will not be damaged due. Ensure forms are clean and free of surface defects prior to erection.
3. Coat contact surfaces of formwork with form-release agent according to manufacturer's written instructions. Agent should be applied minimally and evenly to avoid puddling.
4. Coating should take place as close as possible to concrete pour, and formwork should be protected from water and other deleterious substances. Before concrete placement, forms shall be reinspected and form release agent reapplied or fixed where required.

D. Construction and Erection of Forms:

1. Brace forms securely against lateral forces and to prevent lateral deflections.
2. Build into the formwork and otherwise make necessary provisions in formwork to accommodate the Work of other Sections of this Specification. Obtain required information and materials from affected trades. Install inserts, sleeves, edge and corner angles, steel frames and the like securely in the formwork to allow sound embedment of their anchorage devices, without displacement, and to provide the required alignment to the formed and finished concrete faces and surfaces. Provide boxouts for items to be provided at a later date. Seal, or fill with readily removable filler all voids in embedded items and sleeves in order to prevent complete or partial filling by intrusion of concrete paste.
3. Provide material with sufficient thickness so that newly placed concrete does not bow, distort or deflect formwork.
4. Concrete Surfaces Not Exposed to View: Contractor may use plywood, lumber, metal and other materials included under this Specification.
5. Reuse of Form Material: Clean thoroughly and repair forming materials prior to reuse. Damaged material which cannot be properly reconditioned to produce Work conforming to this Specification shall be discarded. Formwork may be reused only the number of times which will assure that concrete surfaces produced will meet the provisions of this Specification. Condition of formwork and use or reuse of formwork shall be subject to acceptance. Where reuse of forms is permitted or accepted, withdraw all nails, clean forms, and repair damaged surfaces by replacement of damaged boards or units. Formwork materials rejected shall be removed promptly from the site.
6. Protect Soft Materials such as Styrofoam from contact by vibrators and other equipment. Evidence of dispersion of such materials into concrete will be considered as evidence for rejection of that concrete.

E. Cellular Polystyrene panels shall be installed with staggered joints and shall be bonded with adhesives recommended by the manufacturer.

F. Form Release Treatment: Clean and treat all removable forms with form release agent prior to placing reinforcement and embedded items. Remove excess form release agent and do not allow agent to come in contact with previously placed concrete or reinforcing steel.

G. Clean and Tighten all forms immediately prior to casting concrete. Retighten formwork after placing concrete to account for concrete shrinkage and the like and to minimize mortar leakage.

- H. Horizontal and Sloped Concrete Surfaces below finish grade which will not be exposed to view, where permitted and where shown in Drawings, may be formed by the use of clean cut trenches in lieu of forms.
  - 1. Provide 3 inches (75 mm) minimum cover to reinforcement at all surfaces formed by earth, rock, or geotextile fabric.
- I. Mud Slabs shall be a minimum of 3" (75 mm) thick and shall be provided at all locations where shown in the Drawings and at other locations where needed to protect adequately the bearing surface.

### 3.3 FABRICATION AND PLACEMENT OF REINFORCEMENT

- A. Reinforcing Steel shall be Shop Fabricated in strict accord with the Shop Drawings, certificates, and other submitted and accepted data. All Work shall conform to the applicable Standards as given herein and as need apply to the Work. Workmanship shall be of the best practice of relevant trades and shall be performed by skilled mechanics making use of modern tools and equipment which are in good condition. To the extent practical, Work shall be accomplished in the shop and not in the field.
- B. Reinforcing Steel, whether existing or provided under this contract, shall be free from paint, oil, dirt, scale, ice, frost, loose rust, grease, clay or other soil, and other substances or coatings which could reduce bond with concrete.
- C. Placing Reinforcing Steel: Comply with the more severe of ACI, CRSI, *Building Code* and this Specification.
- D. Reinforcing Bar Supports shall be appropriate to the intended use, of sufficient number, spacing, rigidity and strength to prevent displacement of reinforcing and to hold reinforcing accurately in correct position both before and during concrete placement. Do not place reinforcing bars more than 2 inches (50 mm) beyond the last leg of continuous bar supports. Do not use bar supports as support for runways, conveying equipment or for any purpose other than for supporting reinforcing bars.
  - 1. Use plastic or hot-dip galvanized supports.
  - 2. Securely tie and support reinforcement to prevent displacement by construction traffic and casting of concrete. Neither top nor bottom bars shall be allowed to sag below tolerances specified by Building Code or required by the Contract Documents. Concrete cover shall be uniformly maintained. Displacement of reinforcing steel and embedded items shall be corrected immediately and additional supports provided to prevent recurrence. Conform explicitly to Article 7.6, ACI 318. Separate adjacent layers of parallel bars with short lengths of #8 (25 mm) rebars placed transverse to and securely tied to separated bars of #8 (25 mm) or smaller size; separator bars for #8 (25 mm) and larger bars shall be of the largest bar size separated.
- E. Tie wires, where applicable, shall be tied to and bent behind bars in such a manner that concrete placement will not force the wire ends toward the exposed concrete surfaces. At exposed concrete surfaces, tie wire ends shall not fall within required clear concrete cover.
- F. Tack Welding of reinforcing steel bars or mesh is prohibited. Reinforcement damaged by arc strikes or arc welding shall be replaced. Welding of reinforcing bar intersections is prohibited.

- G. Coordination Detailing and Erection: Reinforcement shall be coordinated, detailed and erected to provide a clear passage for the positioning of tremie trunks in required locations. These openings shall be free of bars, bar ends, wire, ties, or obstructions which could hamper insertion and removal of the trunk.
- H Macro Synthetic Fibers: Provide where specified for slabs-on-grade and toppingslabs. Shall be added at a dosage of 4 lbs/cy or higher as required to achieve a minimum equivalent residual strength  $f_{e3}$  of 200 psi when measured in accordance with ASTM C1609.
- I. After-Set Inserts or Post-Installed Anchors: At wall and slab surfaces to receive after-set inserts or post-installed anchors, with written acceptance, it may be possible to place reinforcing steel. Whether or not permission is obtained, Contractor shall not cut or damage reinforcing steel in setting of after-set inserts or post-installed anchors or for any other reason.
- J. Lap Splices: Reinforcing bars may be lapped in contact splices wired together or by lap lengths separated by spacing shown or noted in the Shop Drawings or permitted by this Specification.
- K. Straightening: Once bent, the shop straightening of reinforcing bars is not permitted. The field straightening of bars that have been embedded in concrete is permitted only where authorized specifically.
  - 1. For field bending, acceptance will require generally that larger bars be heated to 1200°F (700°C) maximum and that concrete be protected by insulation blankets. After straightening, acceptance will require that bars be insulated and cooled slowly.

### 3.4 JOINTS

- A. Construction Joints:
  - 1. Construction joints shall be made and located so as to least impair the strength and appearance of the structure. Construction joints shall be made only at locations shown in the Contract Drawings or accepted specifically. Construction joints shall conform to the *Building Code* and to ACI 318, Article 6.4. Location of all construction joints not shown in the Drawings shall be submitted for acceptance.
    - a) All construction joints shall be keyed not less than 1-1/2 inches (40 mm) deep. Wood box-outs treated with a form release agent or cellular polystyrene box-outs shall be used for keying concrete; the chipping of keys after concrete placement as a construction methodology is prohibited. Continue all reinforcing steel across construction joints. Contractor shall supply, fabricate, and place additional reinforcing steel where location of construction joint in any way weakens the construction.
    - b) Horizontal construction joints will not be permitted in slabs except where shown in the Drawings. Horizontal construction joints in walls will not be permitted except where shown in the Drawings or in accepted Shop Drawings.
    - c) Where terrazzo, pavers, stone or other overlay finishes are required, locate slab construction joints accurately at locations directly below expansion joints in the overlay material. Waiver of this requirement will not be given except that, for sand-bedded finishes, alternative proposals will be considered.
  - 2. Spacing of Construction Joints: Conform to and do not exceed maximum distance between construction joints as shown or noted in the Drawings and in this Specification.

3. Special Roughened Construction Joints (SRCJ): For construction joints noted in the Drawings, in addition to keying, the hardened concrete joint face shall be cleaned totally free from laitance either by applying a spray-on surface retarder to the fresh concrete and water blasting or by bush hammering. Provide a rough, sound surface with a roughness amplitude not less than 1/4 inch (6 mm) between projecting aggregate faces and recessed sand-cement matrix. Other construction joint roughening means and procedures are subject to acceptance.
- B. Joint Filler: Joint filler shall be installed where indicated in the Drawings. Joint filler shall be full depth of joint and shall be set flush with exposed concrete surface, except where sealant or a reveal is indicated, in which case the joint filler shall be set back as detailed in the Drawings.

### 3.5 EMBEDDED WORK

- A. General: Locate, set and build into the Work such embedded items as are required by the Work of this Section and by the Work of other Sections and Divisions of this Specification.
  1. All embedded items required for adjoining Work or for its support shall be placed prior to placing of concrete and, where practicable, prior to placing reinforcing steel.
  2. All other trades whose Work is related to cast-in-place concrete Work or whose work must be supported by cast-in-place concrete shall be given ample notice and opportunity to install or furnish embedded items before the affected concrete is placed.
  3. Obtain setting diagrams and instructions from the supplier of item to be set and follow instructions implicitly.
  4. Provide templates, set accurately to line and to level by transit and/or by laser level and anchor securely so as to not displace during placing and compaction of concrete.
  5. Seal, temporarily pack and protect inserts and sleeves from intrusion of concrete or concrete mortar during concrete placement operations.
  6. Aluminum: No aluminum shall be embedded in or shall be installed in contact with concrete Work unless provided with an accepted protective coating.
- B. Post-Installed Anchors shown in the Drawings, or accepted in writing, shall be installed in strict accord with Manufacturer's Printed Installation Instructions. Anchors may be placed in block or brick work only where voids within 9 inches (230 mm) of the anchor have been filled solidly, with grout. Set perpendicular to concrete surface. Drilled holes shall be cleaned thoroughly with compressed air or water jet.
- C. Pipes and Conduit: Location and spacing of piping and of electrical conduit embedded in structural concrete shall conform to Contract Documents, accepted Shop Drawings, to ACI 318, and to *Building Code*. Do not place pipes or conduits in concrete Work except where shown in accepted Shop Drawings.

### 3.6 MIXING AND DELIVERY OF CONCRETE

- A. Ready-Mixed Concrete: All concrete shall be ready-mixed concrete. Measure, mix and deliver in accordance with ANSI/ASTM C 94, *Specification for Ready-Mixed Concrete*, and ACI 304R, Chapters 2, 3, 4, and 5 *Guide for Measuring, Mixing, Transporting and Placing Concrete*.
  1. Plant equipment and facilities shall conform to the Check List Certification of Ready-Mix Concrete Production Facilities of the National Ready Mixed Concrete Association.
  2. Ready mix equipment shall be completely automated.

- a) Computerized batch/truck ticket printouts shall be delivered to the Owner or Owner's inspection agency at time of concrete delivery to job site.
3. Provide site equipment in sufficient time to permit inspection, calibration, adjustment and repair as may be required before start of concrete Work.
4. Admixtures shall be measured and inserted into the mix at the plant except where written exceptions are obtained. The concrete producer shall provide a redosage chart for the high range admixture. This procedure assures a slump or slump flow is in the approved envelope.
5. Self-consolidating concrete should not be batched in quantities greater than 80% of the concrete truck capacity to prevent spillage during transit. Concrete truck operators should keep the revolving drum turning in the mixing mode direction while in transport.
6. If accepted by Structural Engineer, subject to the following conditions, water and/or admixtures may be added to the concrete at the site:
  - a) Water shall not be added during transit, on site, or during placement to self-consolidating concrete.
  - b) Design mixes indicate water and/or admixtures to be added at the site.
  - c) Batch/truck tickets indicate the maximum amount of water and/or admixtures that can be added without exceeding the maximum specified water/cementitious ratio or admixture dosage.
  - d) Water and/or admixtures are added in a manner to control volume.
  - e) Concrete is properly remixed after addition of water and/or admixtures.
  - f) Dosage and time of addition at the site are reported on batch/truck tickets and signed by Contractor's site quality control supervisor.
- B. Hand-Mixed Concrete shall be used only where accepted specifically. Such concrete shall be mixed only in watertight containers, with dry materials measured by loose volume, sand and cement mixed together dry prior to adding coarse aggregate. Water, when added, shall be applied slowly with the entire mass turned to provide for an even mixture at all times.
- C. Hot and Cold Weather: Comply with ACI 305 for hot weather and with ACI 306 for cold weather concreting.
  1. Where air temperature is between 85°F (30°C) and 90°F (32°C), reduce the mixing and delivery time from 1-1/2 hours to 1-1/4 hours; where air temperature exceeds 90°F (32°C), reduce mixing and delivery time to 60 minutes.
  2. Where air temperature is below 40°F (4°C), uniformly heat both water and aggregates to obtain a concrete mixture with a temperature both above 50°F (10°C) and below 80°F (27°C) at all times of mixing, transportation and placement.
  3. Use accelerating admixture in concrete for slabs placed at ambient temperatures below 50°F (10°C).
  4. Freeze resistant concrete design mixes are acceptable for use provided they have been submitted and approved prior.
  5. Self-consolidating concrete placement shall be prohibited during cold weather conditions as defined in ACI 306, *Cold Weather Concreting*.
  6. Self-consolidating concrete placement shall be prohibited during hot weather conditions as defined in ACI 305, *Hot Weather Concreting*.
- D. Cement: At its own expense, Contractor will be required to test or to retest cements which may be contributing to nonconforming concrete, may have been damaged in transit or storage or may have been retained at mixing plant for 30 days or longer.



### 3.7 PLACING CONCRETE

- A. Codes: Concrete shall be placed in accordance with ACI 304R, *Guide for Measuring, Mixing, Transporting and Placing Concrete*, and shall be handled with due care to prevent deterioration due to delay or handling. Concrete shall be consolidated in accordance with ACI 309R.
- B. Clean Reinforcement, whether existing, previously placed, or placed for the pour, to a condition not less clean than is required by this Specification, including referenced, cited and stipulated Codes and Standards.
- C. Clean and Seal Formwork: Formwork shall be clean and free from frost, papers, sawdust, dirt and debris immediately prior to and during the time concrete is placed thereon.
- D. Concrete Pumping: Subject to the provisions of this Specification, ACI 304R - Chapter 9 and ACI 304.2R, concrete may be conveyed and placed by pumping. Concrete shall be pumped through lines 5 inches (125 mm) in diameter or larger. Pumped concrete mix should provide the maximum practicable coarse aggregate content. Lightweight aggregate, where proposed for pumping, shall contain optimum moisture content for pumping, but not less than 16 percent absorbed moisture, based on the oven-dry weight of the lightweight aggregate. Pump lines shall be properly lubricated per ACI 304.2 prior to commencement of concrete placement.
- E. Slump and Slump-Form: Concrete with slump or slump-flow exceeding the limits specified herein shall not be placed in the Work. Concrete with excessive slump shall be removed immediately from the site or may be used as lean concrete.
- F. Conveying of Concrete: This Specification contemplates movement of fresh concrete from the point of receipt to the location of final deposit by concrete pumps, chutes, concrete bucket, pneumatic-tired buggies and combinations of the foregoing methods. Canvas or rubber "elephant trunks" of appropriate lengths shall be used to limit free fall of concrete. Chutes shall not be used to transport concrete for distances in excess of 30 feet (9 m) nor shall chutes be sloped greater than 1 vertical to 2 horizontal. Baffle plates shall be provided and other means shall be taken to prevent segregation. All devices used for conveying concrete shall be watertight, shall not allow concrete to come in contact with uncoated aluminum or with aluminum alloys and shall be cleaned thoroughly prior to use.
- G. Protect formwork from damage by conveying equipment and systems
- H. Clean, Tighten, Soak and Bonding Compound: Prior to placing fresh concrete, retighten forms against previously placed concrete. Existing and previously cast concrete surfaces shall be first cleaned of laitance and deleterious materials, the surfaces shall be then roughened so as to remove all loose or damaged material that may be present. Finally, concrete surfaces shall be soaked with water. Standing water shall be removed. In addition to soaking with water, apply the specified bonding compound within a 24 open hour time frame in accordance with manufacturer's printed instructions to the following:
  - 1. Vertical surfaces along slab-to-slab, slab-to-wall, and beam-to-beam joints.
  - 2. Horizontal surfaces along slab-to-wall joints.
  - 3. Other surfaces where indicated in the Drawings.

Contractors procedures shall recognize that substantial shearing stresses in the horizontal plane are carried across most construction joints.

- I. Coordination of Concrete Placement: The batch plant, transit, conveying and placing operations shall be coordinated so that all concrete is in its final position within 1-1/2 hours from the time the mix is charged with water. Do not place concrete warmer than 90°F (32°C) except as provided in this Specification; for Architectural Concrete, the acceptable temperature of deposited concrete shall be between 50°F (10°C) and 86°F (30°C); for slab-on-ground concrete, the acceptable temperature of deposited concrete shall be between 50°F (10°C) and 70°F (21°C). The batching plant shall either provide chilled batch water or substitute crushed ice for part of the mixing water if required to satisfy specified concrete placing temperatures. Coordination shall be performed so that every deposit placed in the forms shall be covered by a subsequent deposit and consolidated within 15 minutes and in a continuous manner. Truck delivery, truck charging, crane positions, bucket size, tremie numbers and locations, lift heights, etc., shall be planned and directed toward achieving homogeneous and consistent placements.
- J. Placement of Concrete: Do not begin until all reinforcing has been placed, secured, and inspected. Partially hardened or retempered concrete shall not be used in the Work. Concrete placement shall be carried out in a continuous manner between construction joints and at such a rate that freshly deposited concrete may be uniformly integrated and made homogeneous at all contact surfaces with preceding deposits of concrete which shall remain both plastic and properly workable by vibration.
  - 1. Placement of concrete elements supported by columns, walls, piers and the like, shall not commence until the supporting concrete is no longer plastic and, in any event, not before a 4 hour waiting period is fully expired.
  - 2. Concrete shall be deposited as near as practicable and possible to its final position in the structure. Placement procedures shall avoid segregation due to rehandling or due to the lateral flowing of concrete induced by gravity or by vertical dropping. To minimize segregation, concrete may not be dropped between reinforcing steel curtains and cages, nor through successive reinforcement grids. Without special acceptance, vertical free fall of concrete shall be limited to 4 feet (1200 mm).
  - 3. Procedures which cause or contribute to excessive segregation of aggregates or cause non-uniform concrete mixtures shall not be used and will be rejected.
  - 4. Place concrete at slumps and using procedures which will produce a homogeneous, properly compacted concrete with uniform finished surfaces.
  - 5. Concrete shall not be placed onto or under water except where permitted specifically by the Drawings or by this Specification.
- K. Placement of Self-Consolidating Concrete: See section *Placement of Concrete* above for additional requirements for self-consolidating concrete.
  - 1. Self-consolidating concrete shall be placed by pump. Where shown in the drawings or noted in these specifications, self-consolidating concrete shall be pumped from the bottom of the formwork.
  - 2. When pumping, self-consolidating concrete shall be used to prime the pump. The self-consolidating concrete used to prime the line shall not be placed in the work.
  - 3. Self-consolidating concrete shall be deposited as near as practicable and possible to its final position in the structure and in no case shall exceed a maximum 30 feet of flowing distance.
  - 4. Self-consolidating concrete shall not be allowed to free fall. The discharge point shall be fully submerged in the placed concrete.
  - 5. Self-consolidating concrete should be poured continuously, without breaks, lifts, or construction joints.
  - 6. Self-consolidating concrete shall not be vibrated.

7. When placing self-consolidating concrete around box-outs or other obstructions, ensure that concrete is placed from one side only and allowed to fill around the entire obstruction.
- L. Cold Joints are defined as joints wherein concrete on one side has hardened sufficiently so that fresh concrete does not mix thoroughly with that concrete. Cold joints, should they occur, shall result in the immediate stoppage of all placement operations. Detailed drawings showing remedial measures, including removal of material, the drilling-in of dowels and anchors, the construction of keys and specially roughened construction joints by bush hammering and all else will be required prior to placing contiguous concrete.
- M. Layering: Concrete may not be placed in layers exceeding 2 feet (600 mm) in depth. Each layer shall be vibrated to the extent necessary to remove voids, honeycombing and the like.
- N. Vibration: In accordance with ACI 309R, with the exception of self-consolidating concrete shall be compacted thoroughly by vibrating to produce a dense, homogeneous mass without voids or pockets and shall be accomplished only by experienced operators. Internal vibrators shall be placed in the concrete vertically and shall penetrate at least 3 to 4 inches (75 to 100 mm) into the preceding lift in order to thoroughly blend adjacent layers. Vibrating techniques shall assure that the matrix is thoroughly and uniformly distributed around all coarse aggregate, including at form faces, thereby providing uniform dense concrete throughout the entire concrete volume. Vibration shall not be used as a means of transporting concrete. Work concrete thoroughly around embedded items.
  1. At exposed concrete faces, take care not to damage face of formwork.
  2. Self-consolidating concrete does not require vibration.
- O. Pinholes: Voids or holes larger than 1/4 inch (6 mm) in largest dimension shall be repaired under the provisions of this Section.
- P. Epoxy Injection: Place concrete at a slump and consistency which will result in dense, waterproof in-place concrete without shrinkage cracks. Should cracking occur, repair by epoxy pressure injection using an accepted injection procedure and low viscosity, 100% solids, moisture insensitive, non-shrink, two-component epoxy.
- Q. Superplasticized Concrete: Note that hydraulic pressures against formwork may be increased substantially with the use of a HRWR and with self-consolidating concrete. Use at all locations where concrete will not flow readily around embedded reinforcement and/or other items, at locations given in the Drawings or in this Specification, at all locations where chloride resistance is required, and as follows:
  1. Use for all concrete with a water cementitious ratio below 0.50.
- R. Slopes to Drains: Lay out screed lines and finish top of concrete surfaces to provide sloped surfaces as shown in the Drawings and as required to produce free-draining surfaces.

### **3.8 OTHER CONCRETE WORK**

- A. Cement Grout:
  1. Grout all items indicated in the Drawings. Grout openings in concrete around conduit, piping and other Work passing through concrete except where non-shrink grout is specified or shown. Mix, place and cure as provided by this Specification.

- B. Non-Shrink Grouting: Provide formwork for grouting, install flowable non-shrink grout, cure, remove grout forms and seal and protect exposed grout edges, all in strict accord with the printed instructions of the grout manufacturer.
- C. Curbs: Strip formwork while still green and steel-trowel surfaces to a hard, dense finish. Provide corners, intersections and terminations that are slightly rounded.
- D. Topping Slabs shall be lightweight, 4000 psi (28 MPa), unless given otherwise in the Drawings or in this Specification.
  - 1. Clean surfaces under topping slab of all oil, debris, laitance and other material which could reduce bond between the topping slab and the underlying materials. Moisten thoroughly, where surface is concrete; do not leave standing water.
  - 2. Place 4 mil (250  $\mu$ m) or thicker polyethylene slip sheet over all surfaces which are not concrete. Then place 10 mil slip sheet over the lower 4 mil slip sheet. Lap and seal slip sheet used as a vapor barrier. Take all precautions needed to protect waterproofing systems and other underlying materials.
  - 3. Reinforce with macro-synthetic fiber reinforcement at a dosage of 4 lbs/cy unless otherwise noted. Maximum shrinkage shall be less than 0.02% at 28 days.
  - 4. Convey and place so as to secure positive compaction and consolidation of topping slab, resulting in uniform, homogeneous concrete, free from segregation. Provide and use appropriate vibrating screeds.
  - 5. Finish Cure and Seal in accord with the requirements contained in the Drawings and in this Specification.

### 3.9 CONCRETE FINISHES AND TREATMENTS

- A. General: Bring surface to level with screeds and strike off. Smooth the resulting surface with bull floats or darbies to remove both high points and low points. Do not add water to or disturb the plastic surface prior to finishing. Accomplish all finishes in accord with ACI 301, except where more stringent requirements are given in this Specification.
  - 1. Unless otherwise provided under this Specification, all flatwork shall receive a monolithic steel troweled concrete finish.
  - 2. Where finished floor is located above the top of the structural slab, provide all required fill and cement finish required to bring floor to final grade or to underside of final finish, as appropriate.
- B. Flatwork Finishes: Apply the following finish types as required by the Drawings and by this Specification:
  - 1. Float Finish: Required for concrete flatwork surfaces which will receive trowel finish, roofing, waterproofing membrane, insulation, sand-bedded terrazzo and similar finishes, composition troweled floor finish, or "floating slabs". After the concrete has been placed, struck off, consolidated and leveled, the concrete shall not be worked further until ready for floating. Floating shall begin when the water sheen has disappeared and/or when the mix has stiffened sufficiently to permit the proper operation of a power-driven float. The surface shall then be consolidated with power-driven floats. Hand floating with wood or cork faced floats shall be used in locations inaccessible to the power-driven machine. Immediately after leveling, the surface shall be refloated to uniform, smooth, granular texture. Wet cure for seven days.

2. Troweled Finish: Required for all concrete flatwork surfaces which will be exposed, or which will receive resilient flooring, carpeting, thin-set floor covering, paint and other thin-film finishes, waterproofing and roofing systems, and any other floor covering requiring a smooth base slab. First, achieve a float finish, and then:
    - a) After the concrete has been placed, struck off, consolidated, screeded and floated, and as soon as the condition of the slab permits, and before it has hardened appreciably, all water film and foreign material which may work to the surface shall be removed by means of lutes.
    - b) Prior to removal of screed, the surface shall be checked for flatness and levelness, and filled or cut down where necessary. Rough finishing shall be repeated with straightedge and float.
    - c) The surface shall be troweled at least twice to a smooth dense finish.
    - d) The first troweling after power floating shall be done by a power trowel and shall produce a smooth surface which is relatively free of defects but which may still contain some trowel marks.
    - e) Where required, additional troweling shall be done after the surface has hardened sufficiently. The finished surface shall be dense and smooth, free of any trowel marks, uniform in texture and appearance. On surfaces intended to receive floor covering, defects that would show through the floor covering shall be removed by grinding.
    - f) Concrete surfaces to receive membrane waterproofing shall receive a trowel finish which leaves the surface smooth and dense, free of voids, projections or ridges.
    - g) These surfaces shall be wet cured for seven days, unless a strippable curing compound is used.
  3. Exposed Float Finish: Required for where indicated in the Drawings and for the tops of all exposed curbs. Use "troweled finish" with a wood or cork float. Wet cure for seven days.
  4. Scratched Finish: Required for concrete flatwork surfaces which will receive concrete or cement fill or which will receive finish material which will be bonded with cement mortar. After the concrete has been placed, struck off, consolidated and leveled, the surface shall be roughened with stiff brushes or rakes before final set. Wet cure for seven days.
- C. Floors: Thoroughly clean all waste material from floors as soon as each segment of Work is completed, and protect Work which may be damaged by this operation in an accepted manner. Be responsible for fallout and for protecting persons, adjacent work and property. Comply with requirements of the *Building Code* and all agencies having jurisdiction.
- D. Deicing Chemicals: In a freezing environment, it is anticipated that Contractor may need to provide or may be required to provide deicing chemicals for use on slab surfaces. The storage and the use of such chemicals is subject to the following requirements:
1. Contractor's attention is drawn to the fact that such chemicals have led to the destructive corrosion of reinforcing steel and to other problems in structures such as this one (including apartments, laboratories, office buildings, schools, and the like).
  2. Storage of such chemicals shall be provided with a complete and an effective barrier to the supporting concrete.
  3. Where such deicers are placed on slabs, they shall be swept up at the earliest practical moment. Where directed, sweeping shall be followed by a wash-down operation.
  4. Deicing chemicals and barrier systems shall be fully compatible with all subsequent finishes and toppings.

5. Formwork, reinforcement, and construction joints shall be protected from all deicing chemicals used on site. Deicing chemicals should never be used to remove ice from reinforcement or formwork.
- E. Structural Repairs: Conform to Section 5.3.7 of ACI 301, *Specifications for Structural Concrete*, and to accepted procedures. Use the specified polymer repair mortars and epoxy adhesives. Proposed structural repairs need be submitted and approved prior to performing the repair.
- F. Out-of-Form Concrete: Achieve the following finish as required by the Drawings, and by this Specification:
  1. It is the intent of this Specification that all painted concrete and all exposed unpainted concrete be cleaned and dressed. Offsets shall be leveled and ground where necessary. In the event remedial action is required, it shall consist of cutting and patching. Causes for remedial action include rock pockets, honeycomb and spalling.
  2. Clean shall mean the removal of all stains, laitance, transferred form oil, curing compound residue, and dirt from the surface in a manner which avoids staining, scarring or scratching the surface. Surfaces to be painted shall be cleaned ready to receive paint. Coordinate with Paint Section of this Specification.
    - a. Apply cleaning/finishing solution in an even manner, break-to-break or joint-to-joint, on surface; allow to set before flushing with a pressure spray. Accomplish in a consistent manner throughout project.
    - b. Treatment shall produce a "matte" surface by removing just the surface of the cement-paste skin.
  3. Dress shall mean removal of all runs, splatters, fins and projections in a manner which avoids scarring, staining or scratching the surface.
  4. Cutting and Patching shall mean the removal of unsound concrete, the wetting of the affected area, the application of a fine aggregate (#30 screen) and cement matrix matching the in-place concrete, to repair surface voids, honeycomb, rock pockets and spalling and the filling of tie holes, and the application and curing of the applied matrix. Patches shall be compacted thoroughly, screeded a little high, and finished flush with float or trowel. Patches shall be kept continuously moist for not less than 7 days.
- G. Waterproofing and Chloride Ion Screen: Apply two coats to exposed concrete surfaces. Apply after cleaning, but prior to patching. Use airless spray and apply in strict accord to manufacturer's printed instructions. Apply consistently, working joint-to-joint and break-to-break.
- H. Hole Cutting in Hardened Concrete:
  1. It is the intent of these Specifications that hole cutting in hardened concrete will not be required. In the event that hole cutting is required, Contractor shall prepare appropriate details and procedures to accomplish the work and shall submit such details and procedures for acceptance. Cutting holes in the hardened concrete shall conform strictly to accepted details and procedures.
  2. Prior to cutting holes, use a pachometer to locate all potentially affected reinforcing bars, conduits and pipes. Perform coring to avoid touching, cutting or damaging existing reinforcement. Cut reinforcement or embedded items only in accord with accepted details and procedures.

### **3.10 CURING, SEALING, HARDENING, DENSIFYING AND PROTECTION**

- A. Curing Formed Concrete: Conform to all applicable recommendations of ACI 305, ACI 306, and ACI 308.
  - 1. Protect newly placed concrete against rain wash, low and high temperature effects and against premature loss of moisture.
  - 2. Heating of concrete for curing in cold weather shall be by means and methods which do not cause carbonization effects in the concrete. Erect wind breaks and weather protection when and where required.
- B. Wet Curing shall be for at least seven days at a temperature of at least 50°F (10°C) by continuous fog spray, immersion in water-tight covering of polyethylene to retain moisture or other accepted means. Do not use chemical curing on surfaces to be wet cured without specific acceptance.
- C. Curing Compounds: Concrete may be cured with the specified curing compound providing the following requirements can be met:
  - 1. All exposed interior slabs, not receiving a liquid densifier, and troweled slabs receiving mastic applied adhesives or "shake-on" hardeners shall be cured with the specified curing and sealing compound. Exterior slabs, sidewalks, curbs, and concrete not receiving a penetrating sealer, may be cured with the specified clear, non-yellowing curing and sealing compound. Maximum coverage shall be 400 ft<sup>2</sup>/gallon on steel troweled surfaces and 300 ft<sup>2</sup>/gallon on floated or broomed surfaces for the curing/sealing compound.
  - 2. Strippable Curing Compound: All slabs, where indicated on the drawings or where approved, shall be cured with the specified strippable curing compound applied in strict accordance with the manufacturer's recommendation.
  - 3. Compounds which diminish bond or adhesion of finish materials, topping slabs, mortars and the like to concrete surfaces shall not be used or shall be totally removed prior to installation of affected Work. Contractor shall coordinate respective subcontractors and shall be solely responsible to determine and to assure compatibility of curing compound with both concrete and with overlying materials.
- D. Polymer Repair Material for Leveling Low Spots shall be mixed, applied, cured and finished in strict accordance with the recommendations and instructions of the manufacturer.
- E. Protection: Protect concrete Work from overloading and from defacement of any nature during construction operations.
- F. Waterproofing and Chloride Ion Screen: Apply compound where specified and where shown in Architectural or Structural Drawings. Follow explicitly manufacturer's printed instructions.

### **3.11 FORM REMOVAL AND RESHORING**

- A. General: Forms shall be removed only after the supported concrete has achieved sufficient strength to allow the structure to support the weight of concrete plus all superimposed live loads and lateral forces including construction live loads to be placed thereon, without damage to the structure, overstress or excessive deflection. Contractor shall perform, at no expense to Owner, all tests and calculations needed to show when forms, formwork supports, shores and reshores can be removed without endangering the structure, subject to the following limitations:

1. Contractor shall be solely responsible for proper removal of forms and maintenance of safe working conditions for personnel.
- B. Vertical forms may be removed 24 hours after concrete is placed contingent upon concrete having been maintained throughout that period at temperatures in excess of 50°F (10°C), upon achieving concrete strength adequate for stripping, and provisional on the implementation of effective curing procedures.

**END OF SECTION 03 30 00**



## SECTION 044200 - EXTERIOR STONE CLADDING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes stone panels set with individual anchors, including units with inscriptions.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for installing inserts in concrete for anchoring stone cladding.
  - 2. Section 079200 "Joint Sealants" for sealing joints in stone cladding system with elastomeric sealants.
  - 3. Section 321440 "Stone Paving" for exterior stone paving.

#### 1.2 DEFINITIONS

- A. Definitions contained in ASTM C 119 apply to this Section.
- B. Stone Cladding Assembly: An exterior wall covering system consisting of stone panels and trim together with anchors, fasteners, and sealants used to secure the stone to the building structure and to produce a weather-resistant covering.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each variety of stone, stone accessory, and manufactured product.
- B. Shop Drawings: Show fabrication and installation details for stone cladding assembly, including dimensions and profiles of stone units.
  - 1. Show locations and details of joints both within stone cladding assembly and between stone cladding assembly and other construction.
  - 2. Include details of sealant joints.
  - 3. Show locations and details of anchors and backup structure.
  - 4. Show direction of veining, grain, or other directional pattern.
  - 5. Include large-scale shaded drawings of inscriptions.
- C. Samples for Initial Selection: For joint materials involving color selection.
- D. Stone Samples for Verification: Sets for each variety, color, and finish of stone required; not less than 12 inches square.
  - 1. Sets shall consist of at least three Samples, exhibiting extremes of the full range of color and other visual characteristics expected and will establish the standard by which stone will be judged.
  - 2. Include samples of inscriptions.
- E. Sealant Samples for Verification: For each type and color of joint sealant required.
- F. Delegated-Design Submittal: For stone cladding assembly.

#### 1.4 INFORMATIONAL SUBMITTALS

##### A. Material Test Reports:

1. Stone Test Reports: For each stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous three years.
2. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer complying with requirements in Section 079200 "Joint Sealants" and indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

#### 1.5 QUALITY ASSURANCE

##### A. Supplier Qualifications: Supplier shall have adequate stock to complete the work within allotted time and allow for breakage, waste, and rejection of stone that does not satisfy requirements for appearance of physical properties.

##### B. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone cladding assemblies similar to that required for this Project and whose products have a record of successful in-service performance. Fabricator shall have the capacity to process material in accordance with the project schedule.

##### C. Installer Qualifications: A firm or individual experienced in installing stone cladding assemblies similar in material, design, and extent to that indicated for this Project, with a verifiable, 10-year record of successful in-service performance.

##### D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical exterior wall showing stone color, texture, finish, and distribution of characteristic marking; distribution and amount of projection/depression in split-face stone surfaces; and color and finished appearance of pointing mortar and joint sealants.
2. Approval of mockup does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

##### E. Inspection of Inscriptions:

1. Before submitting scale elevations of stonework with inscriptions, lay out work full scale on shop floor. Lay out actual finished stone panels proposed for the wall, to accurately represent in-place panel locations and jointing. Show all graphics to be incised in the panels. Notify Architect when the layout is ready for inspection.
2. Architect will examine the layout for graphics alignment, spacing, dimensions, and correctness, as well as stone jointing, texture, color, and distribution of characteristic markings.
3. Modify the layout as directed until accepted. Execute incising per accepted layout, subject only to the conditions of acceptance.

## 1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Sealant Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 079200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.
- B. Preconstruction Field Testing of Sealants: Before installing joint sealants, field test their adhesion to joint substrates according to Section 079200 "Joint Sealants."

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
  - 1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
  - 2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.
- B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.
- C. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.

## 1.8 FIELD CONDITIONS

- A. Protect stone cladding during erection by doing the following:
  - 1. Prevent staining of stone from sealants and other sources. Immediately remove such materials without damaging stone.
  - 2. Protect base of walls from rain-splashed mud by coverings spread on ground and over wall surface.
- B. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F or when joint substrates are wet.

## 1.9 COORDINATION

- A. Coordinate installation of inserts that are to be embedded in concrete or masonry, flashing reglets, and similar items to be used by stone cladding Installer for anchoring, supporting, and flashing of stone cladding assembly. Furnish setting drawings, templates, and directions for installing such items and deliver to Project site in time for installation.
- B. Time delivery and installation of stone cladding to avoid extended on-site storage and to coordinate with work adjacent to stone cladding.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations for Stone: Obtain each variety of stone from single quarry with resources to provide materials of consistent quality in appearance and physical properties.
- B. Source Limitations for Other Materials: Obtain each type of stone accessory, sealant, and other material from single manufacturer for each product.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stone cladding assemblies.
- B. General: Design stone anchors and anchoring systems according to ASTM C 1242.
  - 1. Stone anchors shall withstand not less than two times the weight of the stone cladding in both compression and tension.
- C. Structural Performance: Stone cladding assembly shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Wind Loads: Calculated in accordance with design criteria indicated on the Drawings.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- E. Safety Factors for Stone: Design stone cladding assembly to withstand loads indicated without exceeding stone's allowable working stress determined by dividing stone's average ultimate strength, as established by testing, by the following safety factors:
  - 1. Safety Factor for Granite: 3.
- F. Design stone anchors to withstand loads indicated without exceeding allowable working stresses established by the following:
  - 1. For Cast-in-Place and Postinstalled Fasteners in Concrete: One-fourth of tested capacity when installed in concrete with compressive strength indicated.
- G. Provisions for Fabrication and Erection Tolerances: Allow for fabrication and erection tolerances of building's structural system.
- H. Corrosion and Staining Control: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Materials shall not stain exposed surfaces of stone and joint materials.

### **2.3 GRANITE**

- A. Material Standard: Comply with ASTM C615.

- B. Description: Uniform, fine-grained stone.
- C. Varieties and Sources: As follows:
  - 1. Type A: Prairie Green, as quarried in the town of Riviere a Pierre, Quebec, Canada.
  - 2. Type B: Stony Creek, as quarried in Branford, Connecticut.
  - 3. Type C: Cambrian Black, as quarried in Alma, Quebec, Canada.
- D. Finish: As indicated on Drawings.
- E. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- F. Match existing stone for color, finish, and other stone characteristics relating to aesthetic effects.
- G. Thickness: As indicated on Drawings.

## 2.4 ANCHORS AND FASTENERS

- A. Fabricate anchors, dowels, and pins from stainless steel, ASTM A 240 or ASTM A 666, Type 316; temper as required to support loads imposed without exceeding allowable design stresses.
- B. Postinstalled Anchor Bolts for Concrete: Chemical anchors, torque-controlled expansion anchors, or undercut anchors made from stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 2 for bolts and nuts; ASTM A 240, ASTM A 276, or ASTM A 666, Type 316, for anchors, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

## 2.5 STONE ACCESSORIES

- A. Setting Shims: Strips of resilient plastic or vulcanized neoprene, Type A Shore durometer hardness of 50 to 70, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.
- A. Weep and Vent Tubes: Medium-density polyethylene tubing, 1/4-inch OD, of length required to extend from exterior face of stone to cavity behind.
- B. Sealants for Joints in Stone Cladding: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and do not stain stone:
  - 1. Joint Sealant: Silicone, nonstaining, S, NS, 100/50, T, NT.
  - 2. Joint-Sealant Colors: As selected by Architect from manufacturer's full range of colors.
- C. Sealant for Filling Kerfs: Same sealant used for joints in stone cladding.

## 2.6 STONE FABRICATION

- A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.

1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
- B. Control depth of stone and back check to maintain minimum clearance of 1 inch between backs of stone units and surfaces of backup walls and other work behind stone.
- C. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.
- D. Cut and drill sinkages and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place.
- E. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples.
- F. Cut stone to produce uniform joints 1/4 inch wide or as indicated on Drawings.
- G. Fabricate molded work, including washes and drips, to produce stone shapes with a uniform profile throughout entire unit length, with precisely formed arris slightly eased to prevent snipping, and with matching profile at joints between units.
  1. Produce moldings and molded edges with machines that use abrasive shaping wheels made to reverse contour of molding shape.
- H. Saw stone backs to approximate true planes. Clean backs to remove rust stains, iron particles, and stone dust.
- I. Inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
  1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.

## 2.7 CARVING AND INSCRIPTIONS

- A. Abrasively etch inscriptions in accordance with approved templates to match samples. Produce clean, sharp edges and clean, smooth, uniformly deep recesses with rounded bottoms.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces to receive stone cladding and conditions under which stone cladding will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone cladding.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone cladding.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SETTING STONE CLADDING, GENERAL

- A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- B. Execute stone cladding installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set.
  - 1. Use power saws with diamond blades to cut stone. Produce lines cut straight and true, with edges eased slightly to prevent snipping.
- C. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with uniform joints of widths indicated, and with edges and faces aligned according to established relationships and indicated tolerances.
- D. Keep cavities open where unfilled space is indicated between back of stone units and backup wall; do not fill cavities with mortar or grout.
  - 1. Place weep tubes in vertical joints, to drain water from cavity bottoms and other locations where moisture may accumulate.
  - 2. Install a row of weep tubes in vertical joints beneath copings. Slope tubes to prevent water entry.
  - 3. Cut tubes flush with joint faces. Do not block tubes with mortar or sealant.

### 3.3 SETTING MECHANICALLY ANCHORED STONE CLADDING

- A. Set stone cladding with mechanical anchors without mortar unless otherwise indicated.
- B. Attach anchors securely to stone and to backup surfaces. Comply with recommendations in ASTM C 1242.
- C. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with sealant indicated for filling kerfs.
- D. Set stone supported on clips or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths and to prevent point loading of stone on anchors. Hold shims back from face of stone a distance at least equal to width of joint.

### 3.4 JOINT-SEALANT INSTALLATION

- A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

### 3.5 INSTALLATION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more. For external corners, corners and jambs within

20 feet of an entrance, expansion joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch in 40 feet or more.

- B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch maximum.
- C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.
- D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/4 inch.
- E. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/8 inch or a quarter of nominal joint width, whichever is less. For joints within 60 inches of each other, do not vary more than 1/8 inch or a quarter of nominal joint width, whichever is less from one to the other.
- F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch difference between planes of adjacent units.

### 3.6 ADJUSTING AND CLEANING

- A. Remove and replace broken, chipped, stained, or otherwise damaged stone, defective joints, and stone cladding that does not match approved samples and mockups. Damaged stone may be repaired if Architect approves methods and results.
- B. Replace damaged or defective work in a manner that results in stone cladding's matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean stone cladding as work progresses. Remove excess sealant and smears as sealant is installed.
- D. Final Cleaning: Clean stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

**END OF SECTION 044200**



## **SECTION 055000 – METAL FABRICATIONS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes stainless steel fabrications for gratings, frames, and benches.
- B. Related Requirements:
  - 1. Section 055213 "Pipe and Tube Railings" for stainless steel handrails.

#### **1.2 COORDINATION**

- A. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

#### **1.3 ACTION SUBMITTALS**

- A. Shop Drawings: Include plans, sections, details, and attachments to other work.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Mill Certificates: Signed by manufacturers of stainless steel certifying that products furnished comply with requirements.
- B. Welding certificates.

#### **1.5 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Paving: Concentrated load of 300 lbf.
  - 2. Limit deflection to L/270 or 1/4 inch whichever is less.

## 2.2 METAL GRATINGS

- A. Stainless Steel Grating: Custom fabrications as indicated on Drawings.

## 2.3 BENCHES

- A. Stainless Steel and Teak Benches: Custom fabrications as indicated on Drawings.

## 2.4 FERROUS METALS

- A. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A240/A240M, Type 316L.
- B. Stainless-Steel Bars and Shapes: ASTM A276, Type 316L.
- C. Stainless Steel Wire: ASTM A580, Type 316L, Condition A.

## 2.5 FASTENERS

- A. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F593 for bolts and ASTM F594 for nuts, Alloy Group 2.
- B. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563, and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- C. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
  - 1. Material: Alloy Group 2 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

## 2.6 FABRICATION

- A. Shop Assembly: Fabricate gratings and benches in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
- F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

## 2.7 GRATINGS AND FRAMES

- A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
1. Fabricate frames and supports from stainless steel shapes and plates. Make bearings true to eliminate rocking and distortion of grating panels. Weld on threaded welding studs for anchorage of removable grating panels.
  2. Drill bolt holes for anchorage to concrete or stone. Weld on stainless steel strap anchors or stainless steel headed welding studs for casting into concrete. Space anchors 24 inches oc max.
  3. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
    - a. Size removable grating sections for easy handling by two men.
  4. Do not notch bearing bars at supports to maintain elevation.

## 2.8 BENCHES

- A. Fabricate bench frame from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
- B. Fabricate bench seat slats of teak lumber, bolted and glued to stainless steel bench frame as indicated.
1. Teak Lumber (*Tectona Grandis*): Surfaced smooth on four sides with eased edges; kiln dried, free of knots, solid stock.
    - a. Grade: Clear.
    - b. Finish: Manufacturer's recommended stain and transparent sealer.

## 2.9 STAINLESS STEEL FINISHES

- A. Remove tool and die marks and stretch lines, or blend into finish.
- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
1. Directional Satin Finish: ASTM A 489/A 480, No. 4.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Fit exposed connections accurately together to form hairline joints.
  - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- D. Field Welding: Comply with AWS recommendations and the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.

#### **3.2 INSTALLING METAL BAR GRATINGS**

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

#### **3.3 CLEANING AND PROTECTION**

- A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

**END OF SECTION 055313**

## **SECTION 055213 - PIPE AND TUBE RAILINGS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

A. Section Includes:

1. Stainless steel handrails.

#### **1.2 COORDINATION**

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves and concrete inserts that are to be embedded in concrete. Deliver such items to Project site in time for installation.
- B. Coordinate installation of light fixtures in railing sections. Refer to Drawings for information.

#### **1.3 ACTION SUBMITTALS**

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- B. Samples: Finished handrail assembly consisting of a supporting post and an attached 12 inch long handrail section.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

#### **1.6 FIELD CONDITIONS**

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.3 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 316L.
- B. Pipe: ASTM A 312/A 312M, Grade TP 316L.
- C. Plate and Sheet: ASTM A240/A240M or ASTM A666, Type 316L.

## 2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
  - 1. For stainless steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
  - 1. Water-Resistant Product: Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

## 2.5 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- C. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units

for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

- D. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- E. Form work true to line and level with accurate angles and surfaces.
- F. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Form Changes in Direction as Follows:
  - 1. As detailed.
- J. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

## 2.6 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines, or blend into finish.
- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
  - 1. Directional Satin Finish: ASTM A 489/A 480, No. 4.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.

- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

### 3.2 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

### 3.3 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

### 3.4 CLEANING AND PROTECTION

- A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- C. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

**END OF SECTION**



## **SECTION 071600 - CEMENTITIOUS WATERPROOFING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes cementitious waterproofing for pool surface.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for finishing concrete walls and slabs to receive waterproofing.

#### **1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, and installation instructions.
- B. Samples for Verification: For each type of waterproofing indicated, in manufacturer's standard sizes.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Applicator.
- B. Product Certificates: For each type of waterproofing, patching, and plugging material.
- C. Product Test Reports: For each product formulation, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Field quality-control reports.

#### **1.5 QUALITY ASSURANCE**

- A. Applicator Qualifications: A firm experienced in applying polymer-modified cement waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and that employs workers trained and approved by manufacturer.

#### **1.6 FIELD CONDITIONS**

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit polymer-modified cement waterproofing to be performed according to manufacturer's written instructions.

- B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.
- C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F or above during work and cure period, and space is well ventilated and kept free of water.

## **PART 2 - PRODUCTS**

- A. Polymer-Modified Cement Waterproofing: Manufacturer's proprietary blend of dry cementitious and other ingredients for mixing with water to produce a waterproof coating that is suitable for vertical and horizontal applications below or above grade, is breathable, resists positive-side hydrostatic pressure, and has properties complying with or exceeding the criteria specified below.
  - 1. Basis-of-Design: Subject to compliance with requirements, provide SikaTop Seal 107 as manufactured by Sika Corporation.
  - 2. Vapor Permeability: Maximum 0.075 perms when tested according to ASTM E96.
  - 3. Compressive Strength: Minimum 5,100 psi at 28 days when tested according to ASTM D695.
  - 4. Tensile Strength: Minimum 770 psi at 28 days when tested according to ASTM C638.
  - 5. Bond Strength: Minimum 820 psi at 14 days when tested according to ASTM C882.
  - 6. Color: Match existing.
- B. Crystalline Waterproofing (Alternate): Prepackaged, gray-colored proprietary blend of portland cement, specially treated sand, and active chemicals that, when mixed with water and applied, penetrates into concrete and concrete unit masonry and reacts chemically with the byproducts of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; with properties complying with or exceeding the criteria specified below.
  - 1. Basis-of-Design: Subject to compliance with requirements, provide Xypex Concentrate as manufactured by Xypex Chemical Corporation.
  - 2. Water Permeability: Maximum zero for water at 30 feet when tested according to COE CRD-C 48.
  - 3. Compressive Strength: Minimum 4000 psi at 28 days when tested according to ASTM C109/C109M.

### **2.2 ACCESSORY MATERIALS**

- A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections and compatible with substrate and other materials indicated.
- B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); and compatible with substrate and other materials indicated.
- C. Water: Potable.

## 2.3 MIXES

- A. Prepackaged, Cementitious Waterproofing: Add prepackaged dry ingredients to mixing liquid according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.
- B. Proceed with application only after unsatisfactory conditions have been corrected.
- C. Notify Architect in writing of active leaks or defects that would affect system performance.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions.
- B. Protect other work from damage caused by cleaning, preparation, and application of waterproofing.
- C. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.
- D. Stop active water leaks with plugging compound.
- E. Repair damaged or unsatisfactory substrate with patching compound.
  - 1. At holes and cracks 1/16 inch wide or larger in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and minimum 1 inch deep. Fill reveal with patching compound flush with surface.
- F. Surface Preparation: Remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.
  - 1. Clean concrete surfaces according to ASTM D4258.
    - a. Scratch- and Float-Finished Concrete: Etch with 10 percent muriatic acid solution according to ASTM D4260.
    - b. Smooth-Formed and Trowel-Finished Concrete: Prepare by mechanical abrading or abrasive-blast cleaning according to ASTM D4259.
  - 2. Concrete Joints: Clean reveals.

### 3.3 APPLICATION

- A. General: Comply with waterproofing manufacturer's written instructions for application and curing.

1. Saturate surface with water for several hours and maintain damp condition until applying waterproofing. Remove standing water.
  2. Apply waterproofing to surfaces, and extend waterproofing onto adjacent surfaces.
  3. Number of Coats: Two.
    - a. Coating Thickness: 47 mils per coat for total thickness of 95 mils.
    - b. Apply first coat as a slurry with brush or roller, and apply subsequent coats with brush, roller, spray, or trowel.
    - c. Vigorously work first coat onto the substrate, forcing the material into surface voids. Apply each subsequent coat into full contact with previous coat.
    - d. Allow manufacturer's recommended time between coats. Dampen surface between coats.
- B. Final Coat Finish: Smooth troweled.
- C. Curing: Cure waterproofing for not less than three days immediately after application and allow to set for 12 days prior to being placed in service.

**END OF SECTION 071613**

## SECTION 079200 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Silicone joint sealants.
  2. Urethane joint sealants.

#### 1.2 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
  3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
  5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
  2. Conduct field tests for each application indicated below:
    - a. Each kind of sealant and joint substrate indicated, using manufacturer's recommended primers.
  3. Notify Architect seven days in advance of dates and times when test joints will be erected.
  4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
    - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
  1. Joint-sealant application, joint location, and designation.
  2. Joint-sealant manufacturer and product name.
  3. Joint-sealant formulation.
  4. Joint-sealant color.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and testing agency.
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer stating that products contain no asbestos.
- C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- E. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
  1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- F. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- G. Field-Adhesion Test Reports: For each sealant application tested.
- H. Warranties: Sample of special warranties.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project with minimum of five years documented experience.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
  - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
- E. Preinstallation Conference: Conduct conference at Project site.

## 1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## 1.7 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS, GENERAL**

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Conform to ASTM C1193 requirements for materials and installation.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### **2.2 SILICONE JOINT SEALANTS**

- A. Single-Component, Traffic Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use T, NT.
  1. Joint Locations:
    - a. Above-grade joints in non-traffic surfaces.
  2. Basis-of-Design Product: Dow Chemical Company; Dowsil 790
    - a. Color: As selected by Architect from manufacturer's full range of colors.

### **2.3 URETHANE JOINT SEALANTS**

- A. Multicomponent, Non-Sag, Traffic-Grade, Urethane Joint Sealant: Multicomponent, non-sag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Uses T, NT, M, A, and O.
  1. Joint Locations:
    - a. Traffic surface joints and joints immersed in water or subject to continual wetting.
  2. Basis-of-Design Product: Tremco Incorporated; Dymeric 240FC.
    - a. Color: As selected by Architect from manufacturer's full range of colors.



## 2.4 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
  - 1. Furnish open-cell or bi-cellular material where required within dual joint seals to permit proper curing of sealant.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
    - d. Exterior insulation and finish systems.
  3. Remove laitance and form-release agents from concrete.
  4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
  2. Do not stretch, twist, puncture, or tear sealant backings.
  3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
  2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
  4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
  5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

### 3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform 10 tests for the first of joint length for each kind of sealant and joint substrate.
    - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
  2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  3. Inspect tested joints and report on the following:
    - a. Whether sealants filled joint cavities and are free of voids.
    - b. Whether sealant dimensions and configurations comply with specified requirements.
    - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
  4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
  5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory.

Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

**END OF SECTION**

## **SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. The requirements contained in this Section apply to all Sections of this Division.
- B. Section Includes:
  - 1. Common terminology and requirements used throughout this Division.
  - 2. Requirements for Acceptance Testing Agency.
  - 3. Requirements for Professional Engineers responsible for Delegated Design.
  - 4. Electrical equipment coordination and installation.
  - 5. Sleeves for raceways and cables.
  - 6. Sleeve seals.
  - 7. Grout.
  - 8. Common electrical installation requirements.

#### **1.2 DEFINITIONS**

- A. AHJ: Authorities Having Jurisdiction.
- B. ANSI GRAY: Where this Section and other Sections of this Division use the term "ANSI GRAY" it shall mean the manufacturer's standard ANSI Gray.
- C. Bound Material: Bound refers to materials permanently bound, as by stitching or glue, or materials securely fastened in their covers by multiple fasteners that penetrate all papers. Ring binders, spiral binders, brads and screw posts are acceptable fasteners. Loose papers clipped together or stapled at one corner are not acceptable.
- D. Business Day: Where this Section and other Sections of this Division use the term "Business Day" it shall mean Monday thru Friday, excluding Holidays recognized by Federal, State and Local government.
- E. EPDM: Ethylene-propylene-diene terpolymer rubber.
- F. FMS: Facility management system.
- G. NETA ATS: Acceptance Testing Specification, as published by InterNational Electrical Testing Association.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. NIST: National Institute of Science and Technology.
- J. RS-232: A TIA standard for asynchronous serial data communications between terminal devices.
- K. RS-485: A TIA standard for multipoint communications using two twisted-pairs.

- L. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

### 1.3 PERFORMANCE REQUIREMENTS

- A. The Drawings diagrammatically show the sizes and locations of various equipment and devices, and the sizes of the major interconnecting wires, without showing exact details as to elevations, offsets, control wiring and other installation requirements. Carefully layout the Work at the site to conform to the architectural and structural conditions, to avoid obstructions and to permit proper grading of pipe associated with other portions of the Work. In cooperation with other trades, determine the exact location of equipment and devices and connections thereto by reference to the submittals and rough-in drawings, and by measurements at the site. Make minor relocations necessitated by the conditions at the site, or directed by the Owner, without additional cost to the Owner.

### 1.4 SUBMITTAL PROCEDURES

- A. Common Requirements for Product Data: Where this Section and other Sections of this Division require Product Data to be submitted, meet the requirements defined in Division 01 Section "Submittal Procedures". In addition to the requirements of Division 01 comply with the following:
  - 1. Submit hardcopy of Product Data in the quantity as required under Division 01 Section "Submittal Procedures". Hardcopies of product data submittals shall be bound materials as defined above. Separate products under distinct subheadings that correspond to paragraphs in specification text. Divide sections in binder with labeled divider tabs.
  - 2. In addition to hardcopies required by Division 01, submit one copy of product data in electronic format. All files shall be in Portable Document Format (.pdf).
  - 3. Product Data shall not consist of manufacturer's catalogs or cut sheets that contain no indication of the exact item offered. The submission on individual items shall designate the exact item offered.
- B. Common Requirements for Shop Drawings: Where this Section and other Sections of this Division require Shop Drawings to be submitted, meet the requirements defined in Division 01 Section "Submittal Procedures". In addition to the requirements of Division 01 comply with the following:
  - 1. Prepare Shop Drawings using computerized drafting software compatible with AutoDesk's AutoCAD®.
  - 2. Submit hardcopy of Shop Drawings in the quantity as required under Division 01 Section "Submittal Procedures". Hardcopies of Shop Drawings shall have each sheet clearly labeled with a unique sheet identification number.
  - 3. In addition to hardcopies required by Division 01, submit one copy of Shop Drawings in electronic format. Files shall include both AutoCAD® compatible source files and files printed to Portable Document Format (.pdf).
  - 4. Shop Drawings shall be of appropriate scale but shall not be smaller than a scale of 1/4-inch equals one foot.
- C. Common Requirements for Coordination Drawings: Where this Section and other Sections of this Division require Coordination Drawings to be submitted, meet the requirements defined in Division 01 Section "Submittal Procedures" and Division 01 Section "Project Management and Coordination". In addition to the requirements of Division 01 comply with the following:
  - 1. Prepare Coordination Drawings using computerized drafting software compatible with AutoDesk's AutoCAD®. Drawings files must be composite with multiple distinctive layers for each of the various trades.

2. Submit hardcopy of Coordination Drawings in the quantity as required under Division 01. Hardcopies of Coordination Drawings shall have each sheet clearly labeled with a unique sheet identification number.
3. In addition to hardcopies required by Division 01, submit one copy of Shop Drawings in electronic format. Files shall include both AutoCAD® compatible source files and files printed to Portable Document Format (.pdf).
4. Coordination Drawings shall be of appropriate scale but shall not be smaller than a scale of 1/4-inch equals one foot.

D. Common Requirements for Qualification Data:

1. Professional Engineer Qualifications: Where this Section and other Sections of this Division require a Professional Engineer to be responsible for Delegated Design requirements; Submit Qualification data for Professional Engineer including, but not limited to, proof of registration in the Project location.
2. Independent Testing and Inspecting Agency Certification: Where this Section and other Sections of this Division require an Independent Testing and Inspecting agency to be responsible for Acceptance Testing and Field Quality Control requirements; Submit certification documentation for such agency that demonstrates compliance with the Quality Assurance paragraph of this Section.

1.5 ACTION SUBMITTALS

A. Product Data: Submit product data for each of the following.

1. Sleeves.
2. Sleeve seals.
3. Grout.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Prepare drawings showing dimensioned layout for the following:

1. Penetration and Structural Opening: Floor plans showing sleeves and formed structural penetrations. Show sleeve and formed penetration layouts and relationships between structural components and other adjacent building elements, including but not limited to pre-tensioning and post-tensioning members where used.
2. Electrical Equipment Layouts: Floor plans, elevations, and other necessary details showing dimensioned layouts for spaces containing electrical equipment. Base electrical equipment dimensions on exact dimensioned data obtained from product submittals for products to be included in the Work. Differentiate between field measurements and assumed dimensions. Include the following items coordinated with each other, based on input from installers of the items involved:
  - a. Electrical equipment layout and relationships between components and adjacent structural and mechanical elements.
  - b. Indication of required working clearances and required area above and around electrical equipment where pipes and ducts are prohibited.
  - c. Location of Conduit entry into electrical equipment.
  - d. Location of luminaires, sprinkler piping and heads, ducts, and diffusers.
  - e. Electrical equipment support locations, type of support, and weight on each support.
  - f. Location of structural supports for structure-supported raceways.
  - g. For floor mounted equipment: concrete base dimension, outline of equipment, and required clearances.

## 1.7 QUALITY ASSURANCE

- A. Common Requirements for Independent Testing and Inspecting Agency Qualifications: Where this Section and other Sections of this Division call for an Independent Testing and Inspecting Agency (Testing Agency); the Testing Agency shall comply with the following requirements:
1. Have the experience and capability to conduct the testing indicated,
  2. Be a member company of the InterNational Electrical Testing Association (NETA) or a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction and the Engineer-of-Record.
  3. Meet the Requirements of NETA ATS 3.0 including, but not limited to, the following:
    - a. Be an independent, third party entity which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems being evaluated.
    - b. Be regularly engaged in the testing electrical equipment devices, installations, and systems.
    - c. Use technicians who are regularly employed for testing services.
    - d. Have a "Full Membership" classification issued by the InterNational Electrical Testing Association meets the above criteria.
  4. Testing Agency's Field Personnel: Technicians performing specified electrical tests and inspections shall meet the Requirements of NETA ATS 3.0 including, but not limited to, the following:
    - a. Technicians performing specified electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make a judgment on the serviceability of the specific equipment.
    - b. Technicians shall be certified in accordance with ANSI/NETA ETT-2000, Standard for Certification of Electrical Testing Personnel. Each on-site crew leader shall hold a current certification, Level III or higher, in electrical testing.
- B. Common Requirements for Material Quality: Materials, equipment and devices shall be new and of the quality specified, and shall be free from defects at the time of installation. Materials, equipment and devices damaged in shipment or otherwise damaged or found defective prior to acceptance by the Owner shall be replaced with new materials, equipment or devices identical with those damaged, unless approved otherwise by the Owner in writing.
- C. Common Requirements for Code Compliance: In case where differences occur between building codes, state laws, local ordinances, industry standards, utility company regulations and the Contract Documents, the most stringent shall govern. Perform the following:
1. Promptly notify the Architect in writing of any such difference.
  2. Obtain approval from Architect before proceeding with the Work.
  3. Should the Contractor perform any work that knowingly does not comply with local codes, laws and ordinances, industry standards, or other governing regulations; the Work shall be corrected at no cost to the Owner.
- D. Common Requirements for Compliance with AHJ Instructions: In cases where the Authority Having Jurisdiction requires deviations from the requirements of the Contract Documents, perform the following:
1. Promptly notify the Architect in writing of any such difference.
  2. Obtain approval from Architect before proceeding with the Work.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.



1. Wherever a UL standard has been established for a particular type of material, equipment or device, each item of such material, equipment or device provided shall meet the requirements of the UL standard.

## 1.8 PRODUCT SUBSTITUTIONS

- A. Comply with provisions of Division 01 Section "Product Requirements Substitution Procedures".
  1. If item of equipment or device offered as Substitution differs in dimension or configuration from that indicated in the Contract Documents, provide, as part of the substitution submittal, a drawing that shows that the equipment or devices proposed for Substitution can be installed in the space available without interfering with other trades or with access requirements for operations and maintenance in the completed project. Drawings shall be of appropriate scale but shall not be smaller than a scale of 1/4-inch equals one foot.
  2. Where substitute equipment or devices requires different arrangement or connections from that indicated in the Contract Documents, install the equipment or devices to operate properly and in accordance with the requirements of the Contract Documents. Make incidental changes necessary in piping, ductwork or wiring which results from the inclusion of the substitute equipment or device without any additional cost to the Owner. Pay all additional costs incurred by other trades in connection with changes required by the inclusion of the substituted equipment or device in the Work.

## 1.9 PROJECT CONDITIONS

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  1. Notify Architect Construction Manager and Owner no fewer than five business days in advance of proposed interruption of electrical service.
  2. Do not proceed with interruption of electrical service without Architect's Construction Manager's and Owner's written permission.
- B. Schedule of Work in Existing Facilities:
  1. The building will continue in use throughout the construction period, carry out the Work in such a manner as to minimize disturbance to the occupants.
  2. The schedule contemplates working in designated areas in the existing building while other adjacent areas are still being occupied. Carry out the Work in such a manner as to minimize disturbance to those occupied areas.
  3. Should the Work in the designated areas affect any services to the areas that are to remain in use, new permanent or temporary services or a combination of both shall be installed as required to enable those occupied areas to function properly and without interruption.
  4. Perform no work in the existing building which would interfere with its use during normal hours of occupancy, Including but not limited to operations which would cause objectionable noise or service interruptions, unless special permission is granted by the Owner.
- C. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving large equipment into place. Where any piece of equipment is too large for ingress through normal building openings it shall be placed in its containing space before the enclosing structure is completed.

- D. Temporary Power: Where temporary power is required during the construction period, comply with ANSI/NECA 200 "Recommend Practice for Installing and Maintaining Temporary Power at Construction Sites."

#### 1.10 COORDINATION

- A. In describing various materials, equipment and devices, in general each item may be described singularly, even though there may be a multiplicity of identical items. Also, where the description is general in nature, the exact sizes, duties, space arrangements, horsepower and other requirements must be obtained by reference to other portions of Contract Documents.
- B. Space allocations for materials, equipment and devices have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer. Verify that all materials, equipment and devices proposed for use on this Project are within the constraints of the allocated space.
- C. Coordinate arrangement, mounting, and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping, ductwork and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- D. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- E. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- F. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- G. For roof-mounted equipment: Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

### PART 2 - PRODUCTS

#### 2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:

- a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
- b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

## 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. The Drawings do not indicate existing installations other than to identify modifications or extensions thereto. Visit the site and ascertain the existing conditions. Review construction details of the existing portion of the building during the site inspection. Include all work required to remove or modify portions of the existing installation in order to accommodate the new Work. Failure to comply with this will not be considered grounds for additional payment in connection with removing or modifying any part of the existing installation or installing any new or temporary work.

## 3.2 TEMPORARY WORKING ACCESS

- A. Remove existing wire, conduit, equipment, fixtures, and other items as required to provide access for Work in existing facilities.
- B. Reinstall and refinish items removed, or otherwise damaged, to match existing adjacent conditions upon completion of the Work.

### 3.3 SALVAGE, DEMOLITION AND RELOCATION

- A. Modify, remove, salvage, or relocate materials, equipment and devices as indicated or required by the installation of new Work.
- B. Salvage and Demolition: Working jointly with the Owner's Representative, establish and mark salvage and demolition items before commencing work; report items scheduled for relocation, reinstallation or reuse, which are found to be in damaged condition; await further instructions from the Owner before commencing Work.
  - 1. Demolition material shall be removed from the site and disposed of in a legal manner.
  - 2. Salvaged equipment and devices shall be the property of the Owner, unless otherwise indicated. Store salvaged items in locations as directed by Owner.
  - 3. For devices and equipment marked for demolition, remove all conduit and wiring back to the point of origination, unless otherwise indicated.
  - 4. Where existing walls are demolished, remove all existing electrical devices, their associated conduit and wiring back to the point of origination.
  - 5. Where entire circuits are removed, turn the circuit breaker off and label as "spare".
  - 6. Maintain service to all "existing to remain" devices and equipment that may be interrupted during demolition.
  - 7. Upon completion of demolition, ensure that remaining devices that may have been interrupted during demolition are energized.
- C. Relocations: Make minor relocations necessitated by the conditions at the site or as directed by the Owner's Representative, without additional cost to the Owner.
  - 1. Remove items which are to be relocated in reverse order to original assembly or placement.
  - 2. Protect items until relocation is complete.
  - 3. Clean, Repair and restore to good functional condition, equipment, materials and items scheduled for relocation. Provide new fittings and appurtenances required to complete the relocations and to restore to good operating order.
- D. Substitution of New materials for Relocation: New materials of similar design and quality may be substituted for materials and items indicated to be relocated upon approval of Owner and Architect. Comply with Division 01 for Substitution Procedures.

### 3.4 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. All materials, equipment and devices shall be installed in accordance with the recommendations of their manufacturer.
- B. Comply with NECA 1 - Standard Practices for Good Workmanship in Electrical Construction, as published by the National Electrical Contractors Association.
- C. Use licensed technicians skilled in their respective trades for installation of the Work.
- D. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items, unless otherwise indicated.
- E. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a manner as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- G. Right of Way: Give to piping systems installed at a required slope.
- H. Access Panels: Provide wall and ceiling access panels for unrestricted access to all concealed electrical equipment items and devices installed behind furrings, chases or non-removable suspended ceilings. Access Panel materials and installation requirements are specified in Division 08 Section "Access Doors and Frames."
- I. Installation Inspections and Certifications
  - 1. Obtain timely inspections of the installation by Authorities Having Jurisdiction. Remedy any deficiencies to the satisfaction of the inspecting official.
  - 2. Upon final completion of the Work, obtain certificates of acceptance from the Authorities Having Jurisdiction. Deliver the certificates to the Owner.

### 3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves where cable or conduit penetrations occur. Install sleeves during erection of slabs and walls.
  - 1. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Exception: Slab-on-grade construction shall not require sleeves or curbed formed openings when conduits or pipes that penetrate the slab-on-grade are installed and properly supported prior to the pouring of the slab.
- C. Masonry Walls: Install sleeves where cable or conduit penetrations occur. Install sleeves during erection of walls.
  - 1. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- F. Non Fire-Rated Assemblies: Install sleeves where cable penetrations occur. Install sleeves during erection of walls.
  - 1. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- G. Cut sleeves to length for mounting flush with both surfaces of walls.
- H. Extend sleeves installed in floors a minimum of 2 inches above finished floor level.
- I. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless otherwise indicated or.
- J. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
  2. Apply approved joint compound for gypsum board assemblies where masonry or concrete wall is faced on interior side with gypsum board.
- K. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- L. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- M. Roof-Penetration Sleeves: Seal penetration of individual conduits and cables with flashing units applied in coordination with roofing work. Provide flashing unit as specified in Division 07 Section "Sheet Metal Flashing and Trim".
- N. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- O. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### 3.6 OPTION TO RELOCATE DEVICES

- A. The location of power, wall switches and other similar devices along with their associated connections may be relocated at the Owner's option, at no additional cost to the Owner, to a point within 10 feet of their present location provided the Contractor is notified prior to rough-in or installation.

### 3.7 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.8 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."
- B. Apply putty pads to boxes located in fire-rated wall assemblies in which a horizontal distance of greater than 24" between boxes is not maintained. Putty pad materials and installation requirements are specified in Division 09 Section "Gypsum Board Assemblies."

3.9 FIELD QUALITY CONTROL

- A. Conduct tests as part of the Work of this Division. Include the services of qualified personnel as well as all equipment, apparatus, and services required.
- B. Conduct tests under conditions free from short circuits and from grounds.
- C. Insure insulation resistance prior to test is within the requirements of the latest edition of the NFPA 70.
- D. Prior to execution of testing, notify Architect of proposed test procedures and forms.
- E. Testing requirements are listed under individual sections of this Division. Sections requiring testing include, but are not limited to the following:
  - 1. Wire and cable insulation, in accordance with Division 26 Section "Low-Voltage Electrical Power Conductions and Cables."
  - 2. Grounding system continuity, in accordance with Division 26 Section "Grounding and Bonding for Electrical Systems."
  - 3. NETA tests and startup for panelboards, in accordance with Division 26 Section "Panelboards."

**END OF SECTION**

## **SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
  - 3. Sleeves and sleeve seals for cables.

#### **1.2 DEFINITIONS**

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.
- C. VFC: Variable frequency controller.

#### **1.3 ACTION SUBMITTALS**

- A. Submit product data and shop drawings in accordance with Division 01 and Division 26 Section "Common Work Results for Electrical" for products specified under PART 2 - PRODUCTS.
- B. Product Data: For each type of product indicated. Provide data for conductors and cables including, but not be limited to, the following:
  - 1. Complete physical properties of the conductors and cables.
  - 2. Ampacity for use intended.
  - 3. Allowable stresses and requirements for installations, including bend radii, linear stress, and other pertinent data.
  - 4. Types of connectors for terminations.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Field quality-control test reports.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For conductors and cables, to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation And Maintenance Data," include the following:
  - 1. Manufacturer's routine maintenance requirements for cables, terminations and all installed components.



## 1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Alcan Products Corporation; Alcan Cable Division.
  - 2. Alpha Wire.
  - 3. Belden Inc.
  - 4. Encore Wire Corporation.
  - 5. General Cable Technologies Corporation.
  - 6. Southwire Incorporated.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. XHHW Conductors: Comply with NEMA WC 70.
- D. Retain paragraph below if specifying VFD's.
- E. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Types THHN-THWN, and SO, as indicated.

### 2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Gardner Bender.
  - 3. Hubbell Power Systems, Inc.
  - 4. Ideal Industries, Inc.
  - 5. IlSCO; a branch of Bardes Corporation.
  - 6. NSI Industries LLC.
  - 7. O-Z/Gedney; a brand of the EGS Electrical Group.
  - 8. 3M; Electrical Markets Division.
  - 9. Tyco Electronics.
  - 10. WAGO Corporation.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

### 2.3 MISCELLANEOUS PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength: 50 lb, minimum.

3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding. Refer to Division 26 Section "Identification for Electrical Systems" for color-coding requirements.

## 2.4 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper for all feeders. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Provide conductors with minimum temperature ratings of 75 degrees C. For high temperature applications, provide conductors with temperature ratings in accordance with the NFPA 70 for the ambient condition.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders:
  1. Copper: Type THHN-THWN, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace:
  1. Copper: Type THHN-THWN, single conductors in raceway.
- C. Feeders below Slabs-on-Grade, and Underground:
  1. Copper: Type THHN-THWN, single conductors in raceway.
- D. Exposed Branch Circuits, Including in Crawlspace:
  1. Type THHN-THWN, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway Coordinate first paragraph below with Division 16/26 Section "Underground Ducts and Raceways for Electrical Systems." And Division 02 Section "Underground Ducts and Utility Structures." or Division 33 "Electrical Underground Ducts and Manholes".
- F. Branch Circuits below Slabs-on-Grade, and Underground in limited locations where indicated: Type THHN-THWN, single conductors in raceway.

- G. Connections to Luminaires on Normal System: Type THHN-THWN, single conductors in raceway as specified in Division 26 Section Raceways and Boxes for Electrical Systems.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- J. Class 2 and 3 Control Circuits; Concealed in Ceilings, Walls or Partitions: Power-limited cable or Type THHN-THWN, in raceway.
- K. Class 2 and 3 Control Circuits; Exposed: Type THHN-THWN, in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Run feeders in continuous lengths, without joints or splices. Where continuous runs are impractical; obtain Engineer's approval for splice locations and application.
- B. Make joints in branch circuits only where circuits divide.
- C. Do not use gutters of panelboards as raceways, junction boxes, or pull boxes for conductors not terminating in said panelboards.
- D. Make splices and terminations in cables with kits and instructions provided by the kit manufacturer. Each splice shall equal the integrity of the cable electrically and environmentally.
- E. Bundling Conductors: Bundle conductors in switchboards, panelboards, cabinets, and the like, using nylon ties made for the purpose. Bundle conductors larger than No. 10 in individual circuits. Smaller conductors may be bundled in larger groups.
- F. Install all conductors in raceways, unless otherwise indicated.
- G. Sizes:
  - 1. Provide conductors no smaller than No. 12 AWG, except for signal or control circuits.
  - 2. Provide No. 10 AWG conductors for home runs on 120-volt, 20-ampere branch circuits, where the conductor length exceeds 100 lineal feet from panelboard to the first device.
  - 3. Provide No. 10 AWG conductors for home runs on 277-volt, 20-ampere branch circuits, where the conductor length exceeds 200 lineal feet from panelboard to the first device.
  - 4. Provide neutral conductors of the same size as the phase conductor(s) for individual branch circuit homeruns.
  - 5. Run dedicated neutral conductor with each branch circuit. Sharing of neutral conductors in multi-circuit homeruns is not acceptable.
    - a. Sharing of neutrals would necessitate the use of multiple-pole or tied branch circuit breakers to allow simultaneous disconnecting of current carrying conductors in order to comply with NFPA 70 requirements and therefore is unacceptable.
  - 6. Grouping of Multi-Circuit homeruns: grouping of multiple circuits into shared conduit homeruns is acceptable where they comply with the quantities and sizes listed in Table "A" below and where homeruns meet the following conditions:
    - a. Where conductors are THWN/THHN installed in dry location.
    - b. Where raceways are installed in ambient conditions less than 30-Deg C (86-Deg F).
    - c. Consider neutral conductors as a current carrying conductor in branch circuits which serve receptacles or electronic ballasted luminaires.

TABLE A

Number of Current Carrying Conductors in single raceway	Conductor Size for 20Ampere Single Pole Circuit	Conduit Size based on EMT
2 to 3	#12 AWG (THHN 75-Deg) or #12 AWG (THHN 90-Deg)	3/4" EMT
4 to 6	#12 AWG (THHN 75-Deg) or #12 AWG (THHN 90-Deg)	3/4" EMT
7 to 9	#10 AWG (THHN 75-Deg) or #12 AWG (THHN 90-Deg)	1" EMT 3/4" EMT
10	#10 AWG (THHN 90-Deg)	1.25" EMT

Notes:

1. Conductor and conduit sizes in table above are based on total conductor lengths under 100 lineal feet for 120-volt (200 lineal feet for 277-volt) from panelboard to the first device, 20-ampere branch circuits. Increase conductor and conduit size in accordance with NFPA 70 for longer lengths.

- H. Terminations of multiple branch circuit conductors on a single circuit breaker is not acceptable.
- I. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- J. Complete raceway installation between conductor and cable termination points according to Division 16 26 Section "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- K. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours.
- L. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- M. Feeders and Branch circuits concealed in concrete are prohibited.

### 3.4 WIRE PULLING

- A. Pull no conductors into conduits until all Work of a nature which may cause injury to conductors is completed.
- B. Follow manufacturers' recommendations for regulating temperature conditions of conductors prior to installation.
- C. Exercise care in handling and installing cables to avoid damage. Carefully form cables in equipment pull boxes. Form bends in cables larger than the minimum radii shown in the cable manufacturer's published data for minimum bends such that bends will not reduce the cable life.
- D. Provide suitable installation equipment to prevent abrasion and cutting of conductors by raceways during the pulling of conductors. Use ropes of polyethylene, nylon or other suitable non-metallic material to pull in feeders. Metallic ropes are prohibited.
- E. Attach pulling lines to conductors by means of insulated woven basket grips or by pulling eyes attached directly to conductors. Do not use rope hitches, or bare steel basket grips. All conductors to be installed in a single conduit shall be pulled in simultaneously.

- F. Before any wire is pulled into any conduit, thoroughly swab the conduit to remove all foreign material and to permit the wire itself to be pulled into a clean, dry conduit.
- G. Use manufacturer-approved pulling compound or lubricant where necessary, of non-conducting type. Compounds used must not deteriorate the conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- H. Do not use cable pulling lubricants on conductors of ungrounded circuits which are electrically monitored by ground detector system, since such lubricant may increase the capacities to ground of these conductors.

### 3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice and tap conductor.
- C. Wiring at Outlets: Install conductor at each device, with at least 6 inches (150 mm) of slack.
- D. Wiring at lighting control locations: Install a neutral conductor at each switch location controlling line-to-neutral lighting loads.
- E. Connectors: Make splices and connections in conductors using approved connectors.
  - 1. Provide lugs and connectors of proper size to match conductor size.
  - 2. Stranded Conductors: Solder-less, bolted pressure or compression connectors.
  - 3. Solid Conductors: Bolted pressure or spring connectors.
  - 4. Motor Lead Pigtails: Crimp lugs with through-bolt fasteners between lugs. Furnish proper sized dies and tools to apply connectors.
  - 5. Lighting Fixture Taps: Electrical spring connectors as specified for solid conductors.
  - 6. Ground Connections: Ground connection materials and installation requirements are specified in Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Provide temperature ratings of connectors and splices to match wire rating.

### 3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### 3.7 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Apply Sleeve and Sleeve Seal where raceways, cables, wireways, penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies. Sleeve and Sleeve Seal

materials and installation requirements are specified in Division 26 Section "Common Work Results for Electrical."

### 3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

### 3.9 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each feeder, and branch circuit.
  - 2. Test continuity of each circuit.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance conductors, and conductors of No. 2 AWG and larger for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for one minute.
- D. Perform continuity test to insure correct cable connection.
- E. Test Values
  - a. Bolt-torque levels shall be in accordance with Table 1.1 thru Table 1.4, unless otherwise specified by the manufacturer.

**Table 1.1 - Bolt Torque for Bus Connection using Cadmium or Zinc Plated Heat-Treated Steel**

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (P.S.I.)	64K	105K	133K	150K
Bolt Diameter (Inches)	Torque (Foot Pounds)			
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1	225.6	372.8	528.0	571.2

**Table 1.2 - Bolt Torque for Bus Connection using Silicon Bronze Fasteners <sup>1</sup>**

	Non-Lubricated	Lubricated
Bolt Diameter (Inches)	Torque (Foot Pounds)	
5/16	15.0	10.0
3/8	20.0	14.0

1/2	40.0	25.0
5/8	55.0	40.0
3/4	70.0	60.0

<sup>1</sup> Bronze alloy bolts with minimum tensile strength of 70,000 pounds per square inch.

**Table 1.3 - Bolt Torque for Bus Connection using Aluminum Alloy Fasteners <sup>2</sup>**

Bolt Diameter (Inches)	Lubricated
	Torque (Foot Pounds)
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

<sup>2</sup> Aluminum alloy bolts with minimum tensile strength of 55,000 pounds per square inch.

**Table 1.4 - Bolt Torque for Bus Connection using Stainless Steel Fasteners <sup>3</sup>**

Bolt Diameter (Inches)	Uncoated
	Torque (Foot Pounds)
5/16	14.0
3/8	25.0
1/2	45.0
5/8	60.0
3/4	90.0

<sup>3</sup> Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy. Belleville washers: 302 alloy.

- b. Minimum insulation-resistance values shall be not less than 50 megohms.
    - c. Investigate deviations between adjacent phases.
  - 2. Infrared Scanning: Perform Thermographic Survey in accordance with NETA ATS, Section 9.0.
    - a. Initial Infrared Scanning: Within 60 Days after Substantial Completion, perform an infrared scan of each termination of or splice in cables and conductors No. 3 AWG and larger. Open or remove doors and covers so connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each termination and splice 11 months after date of Substantial Completion.
    - c. Instruments, Equipment:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - d. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- F. Cables will be considered defective if they do not pass tests and inspections.
- G. Correct Deficiencies, Retest and Report:
  - 1. Correct unsatisfactory conditions, and retest to demonstrate compliance; replace conductors, units, and devices as required to bring system into compliance.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Prepare a written report to record the following:
    - a. Procedures used.
    - b. Results that comply with requirements, identifying conductor, units, and devices checked.

- c. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- d. Observations and test results after remedial action.

**END OF SECTION**



## **SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. NFPA 70 and IEEE C2 include basic grounding requirements for electrical safety. This Section supplements the minimum safety requirements of the Code with requirements for additional grounding and with optional grounding methods and materials for both power and electronic systems.
- B. This Section includes methods and materials for grounding and bonding systems and equipment.

#### **1.2 ACTION SUBMITTALS**

- A. Submit product data and shop drawings in accordance with Division 01 and Division 26 Section "Common Work Results for Electrical" for products specified under PART 2 - PRODUCTS.
- B. Product Data: For each type of product indicated.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Field quality-control test reports.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For grounding, to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation And Maintenance Data," include the following:
  - 1. Manufacturer's routine maintenance requirements for cables, terminations and all installed components.

#### **1.5 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with NFPA 70.
- D. Comply with IEEE C2.
- E. Comply with ANSI-J-STD-607-A.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Burndy; Part of Hubbell Electrical Systems.
  2. Dossert; AFL Telecommunications LLC.
  3. ERICO International Corporation.
  4. Fushi Copperweld Inc.
  5. Galvan Industries, Inc.; Electrical Products Division, LLC.
  6. Harger Lightning and Grounding.
  7. ILSCO.
  8. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
  9. Robbins Lightning, Inc.
  10. Siemens Power Transmission & Distribution, Inc.

### **2.2 CONDUCTORS**

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
  2. Stranded Conductors: ASTM B 8.
  3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  6. Main Bonding Jumper: stranded copper conductors sized as indicated on Drawings.
  7. Grounding Electrode Conductor: stranded copper conductors sized as indicated on Drawings.
  8. Common Grounding Electrode Conductor: stranded copper conductors sized as indicated on Drawings.

### **2.3 CONNECTORS**

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, long barrel with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.

### **PART 3 - EXECUTION**

#### **3.1 APPLICATIONS**

- A. Conductors: Insulated solid or stranded for No. 10 AWG and smaller, insulated stranded for No. 8 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum.
  - 1. Bury at least 30 inches below grade.

#### **3.2 EQUIPMENT GROUNDING**

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
  - 1. Bond to each device, box, and luminaire, unless otherwise indicated.
  - 2. Conduction insulation of the same rating as the phase conductors, for all feeders and branch circuits. Install the grounding conductors in the raceway with related phase and neutral conductors.
  - 3. Where parallel conductors in separate raceways occur, provide a grounding conductor in each raceway that meets requirements of NFPA 70.
- B. Enclosures: Install an insulated grounding conductor from grounding bushings to the frame of the enclosure, ground bus, and equipment grounding strap where each occurs. Install grounding bushings on all raceways connecting electrical enclosures constructed of separate enclosure panels, which are not integrally welded together.

#### **3.3 INSTALLATION**

- A. Provide permanent service neutral and equipment grounding in accordance with NFPA 70 and subject to the following additional requirements.
- B. Comply with mounting and support requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Connect the service neutral and equipment ground to a common point within the metallic enclosure containing the main service disconnecting means. Equipment grounds and the identified neutral of the wiring system shall not be interconnected beyond this point in the interior wiring system. From the common point of connection of the service neutral and the equipment ground, run in non-magnetic conduit a grounding electrode conductor without joint or splice to the grounding electrode system and connect it with an approved bolted pressure clamp.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
  - 4. Where expansion joints or telescoping joints occur, provide bonding jumpers.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components as specified in Division 26 Section "Identification for Electrical Systems."

3.5 CONNECTIONS

- A. Ground Connections: Provide ground clamps or connectors of a suitable type for ground applications.

3.6 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
- B. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
  - 1. Report measured ground resistances that exceed the following values:
    - a. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
- E. Correct Deficiencies, Retest and Report:
  - 1. Correct unsatisfactory conditions, and retest to demonstrate compliance; replace conductors, units, and rods as required to bring system into compliance.
  - 2. Prepare a written report to record the following:
    - a. Procedures used.
    - b. Results that comply with requirements, identifying components checked.
    - c. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
    - d. Observations and test results after remedial action.

**END OF SECTION**

## **SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes:
  - 1. Metal conduits, tubing, and fittings.
  - 2. Metal wireways and auxiliary gutters.
  - 3. Surface raceways.
  - 4. Boxes, enclosures, and cabinets.
- B. Provide raceways and boxes for all the other systems, as specified in other Sections of Divisions 26, 27 and 28.

#### **1.2 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical non-metallic tubing.
- C. EPC: Electrical Plastic Conduit
- D. EPDM: Ethylene-propylene-diene terpolymer rubber.
- E. FMC: Flexible metal conduit.
- F. IMC: Intermediate metal conduit.
- G. LFMC: Liquidtight flexible metal conduit.
- H. LFNC: Liquidtight flexible nonmetallic conduit.
- I. NBR: Acrylonitrile-butadiene rubber.
- J. RAC: Rigid aluminum conduit.
- K. RMC: Rigid metal conduit.
- L. RSC: Rigid Steel conduit.

#### **1.3 ACTION SUBMITTALS**

- A. Submit product data and shop drawings in accordance with Division 01 and Division 26 Section "Common Work Results for Electrical" for products specified under PART 2 - PRODUCTS.
- B. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

- C. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store raceway components indoors to prevent water or other foreign materials from staining or adhering to components. Unpack and dry wet materials before storage.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit.
  - 3. Anamet Electrical, Inc.
  - 4. Electri-Flex Company.
  - 5. FSR Inc.
  - 6. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
  - 7. Patriot Aluminum Products, LLC.
  - 8. Picoma Industries.
  - 9. Republic Conduit.
  - 10. Robroy Industries.
  - 11. Southwire Company.
  - 12. Thomas & Betts Corporation.
  - 13. Western Tube and Conduit Corporation.
  - 14. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RSC: Comply with ANSI C80.1, UL 6, and NEMA FB 2.10; Galvanized rigid steel, each length with a coupling on one end and thread protector on opposite end.
- D. IMC: Comply with ANSI C80.6, UL 1242, and NEMA FB 2.10.
- E. Fittings for RSC and IMC: Provide factory made threaded couplings of same material as the conduit.
  - 1. Molded thermoplastic insulating bushing at all boxes and cabinets, with locknuts inside and outside box or cabinet. In wet locations, provide watertight hubs for conduit entry into enclosures.
  - 2. Thermoplastic insulated grounding bushing on all conduits where grounding bushings are required, with locknuts inside and outside the enclosure. In wet locations provide watertight hubs for conduit entry into enclosures.

3. Expansion joints: O-Z/Gedney or acceptable submission, with internal ground and external bonding jumper.
  - a. Expansion fitting: Type AXB.
  - b. End type expansion fitting: Type EXE.
  - c. Deflection fitting: Type DX.
  - d. Pull box fitting: Type EXPB.
  - e. Combination expansion/deflection fitting: Type AXDX.
- F. Conduit fittings for Hazardous (Classified) Locations: Comply with UL 886.
- G. PVC-Coated Steel Conduit: Comply with NEMA RN 1 and ETL PVC-001; PVC-coated RSC or IMC with 0.040 inch, minimum coating thickness.
- H. Coating for fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- I. EMT: ANSI C80.3 and UL 797.
- J. Fittings for EMT:
  1. Steel, set-screw couplings.
  2. Steel, set-screw insulated throat box connectors with molded thermoplastic insulating bushing at all boxes and cabinets, with locknuts inside box or cabinet.
  3. Steel, set-screw insulated throat box connectors with thermoplastic insulated grounding bushing on all tubing where grounding bushings are required.
  4. Expansion joints: O-Z/Gedney, type TX or acceptable submission, with internal ground and external bonding jumper.
  5. Insulated throat material for fittings to be of a color that is easily distinguishable; clear thermoplastic throats are not acceptable.
- K. FMC: Comply with UL 1; Zinc-coated steel.
- L. LFMC: Comply with UL 360; Flexible steel conduit with flame retardant PVC jacket and copper grounding strand.
- M. Fittings for FMC and LFMC: Comply with NEMA FB 1 and UL 514B.
  - a. Adapters at connections between flexible and rigid conduit.
  - b. Thermoplastic insulated throat, steel connectors at box or cabinet terminations.
  - c. Insulated throat material for fittings to be of a color that is easily distinguishable; clear thermoplastic throats are not acceptable.
- N. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
- O. Wire Support Bushings: Provide for vertical runs as required by the NFPA 70. Select for the conductor size involved.
  1. For conductors NO. 8 AWG and smaller provide galvanized, non-insulating type.
  2. For conductors No. 6 AWG and larger provide O-Z/Gedney, Type SR, insulating type.
- P. Joint Compound for RSC or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

## 2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
  - 2. Hoffman; a brand of Pentair Equipment Protection.
  - 3. Mono-Systems, Inc.
  - 4. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, type and sized according to NFPA 70 as required.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 870.
- D. Fittings and Accessories:
  - 1. Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
  - 2. Construct wireways with/without knockouts, as required.
  - 3. Provide spring nuts or guards on all screws installed toward the inside to prevent wire insulation damage.
- E. Wireway Covers:
  - 1. Hinged type unless access restrictions require screw-cover type.
  - 2. Flanged-and-gasketed as required for NEMA type.
  - 3. Construct cover to close without the use of parts other than the standard lengths, fittings, and connectors.
  - 4. Provide provisions for the cover to be sealed in the closed position with a sealing wire.
- F. Finish: Manufacturer's standard enamel finish.

## 2.3 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers, complying with UL 5. Prime coating, ready for field painting.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hubbell Incorporated; Wiring Device-Kellems.
    - b. MonoSystems, Inc.
    - c. Panduit Corp.
    - d. Wiremold / Legrand.
- C. Surface raceways used together with couplings, clips, bushings, straps, connectors, connection covers, elbows, boxes, extension boxes, fixture boxes, extension adapters, blank covers and all other required fittings; size to accommodate the conductors to be installed therein in each case.



## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Adalet.
  - 2. Cooper Technologies Company.
  - 3. EGS/Appleton Electric.
  - 4. Erickson Electrical Equipment Company.
  - 5. FSR Inc.
  - 6. Hoffman; a brand of Pentair Equipment Protection.
  - 7. Hubbell Incorporated.
  - 8. Kraloy.
  - 9. Milbank Manufacturing Co.
  - 10. MonoSystems, Inc.
  - 11. Oldcastle Enclosure Solutions.
  - 12. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
  - 13. RACO; Hubbell.
  - 14. Robroy Industries.
  - 15. Spring City Electrical Manufacturing Company.
  - 16. Thomas & Betts Corporation.
  - 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Sheet Metal Pull and Junction Boxes: Comply with NEMA OS 1.
  - 1. Construct boxes from code gauge sheet steel no lighter than 14 gauge with overlapped riveted or welded corners and with edges turned to receive trim.
  - 2. Construct covers from same gauge as box with screw fasteners. Sectionalize boxes over 864 square inches.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Gangable boxes are allowed.
- I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- J. Cabinets:
  - 1. Comply with NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

### **PART 3 - EXECUTION**

#### **3.1 RACEWAY APPLICATION**

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
  1. Above Ground: RSC, or IMC.
  2. Within Crawl Spaces: RSC, or IMC.
  3. Emergency Feeders: RSC
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R, unless otherwise indicated.
- B. Comply with the following indoor applications, unless otherwise indicated:
  1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed and Subject to Physical Damage: RSC, or IMC. Includes, but is not limited to, raceways in the following locations:
    - a. Mechanical rooms.
  3. Conductors over 600 volts: RSC, or IMC.
  4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  5. Concealed within Masonry Walls: RSC, or IMC.
  6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  7. Damp or Wet Locations: RSC, or IMC.
  8. Elevator Pits: RSC, IMC, or LFMC.
  9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
  10. Emergency feeders and branch circuits: EMT.
  11. Corrosive Locations: PVC-Coated RSC, PVC-Coated Steel Conduit.
- C. Minimum Raceway Size:
  1. Individual Branch Circuits: 3/4-inch(21-mm).
  2. For feeder circuits and multiple branch circuits: 3/4-inch
- D. Provide minimum 1/2"-inch(16-mm) conduit for controls circuiting.
- E. Junction and Pull Boxes: Sheet steel boxes, unless otherwise indicated.
  1. Provide boxes no smaller than 4 inches square and 2-1/8 inches deep.
  2. Size all junction and pull boxes in accordance with the NFPA 70, unless project conditions dictate use of larger boxes.
- F. Outlet and Device Boxes: Sheet steel boxes, unless otherwise indicated.
  1. For Wall Switches, Receptacles, and Communication Use: 4 inch square, one-piece. Use boxes with plaster rings in all plastered walls where wall thickness permits. Use boxes 1-1/2 inch deep only in locations where deep boxes cannot be accommodated by construction.
- G. Boxes Used Outdoors or in Damp/Wet Locations: Cast metal boxes with gasketed covers and threaded hubs.

### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Store conduit in dry locations during construction. Swab conduits out prior to pulling conductors.
- C. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel, unless intumescent putty pads are installed according to Division 07 Section "Penetration Firestopping."
- D. Locate boxes so that cover or plate will not span different building finishes.
- E. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- F. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- G. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- H. Recessed Boxes in Fire-Rated Partitions: For boxes located on opposite sides of same partition do not install boxes back-to-back; separate boxes with a minimum of 24 inch separation, unless otherwise indicated in the installation requirements specified in Division 07 Section "Penetration Firestopping."
- I. Recessed Boxes in partitions around Acoustically-Sensitive Spaces: For boxes located on opposite sides of same partition do not install boxes back-to-back; separate boxes with a minimum of 24 inch separation. Acoustically-Sensitive Spaces include, but are not limited to, the following:
  - 1. Conference Rooms, Meeting rooms and similar spaces.
  - 2. Classrooms, Training Rooms and similar spaces.
  - 3. Interview Rooms, Consultation Rooms and similar spaces.
  - 4. Auditoriums, Lecture Rooms, and similar spaces.
  - 5. Ballrooms, Private Dining, and similar spaces.
  - 6. Other spaces specifically listed in the Project Acoustic Consultants' recommendation reports or specifications.
- J. On concealed conduit systems where boxes are not otherwise accessible, set boxes flush with finished surfaces for access, and provide overlapping covers.
- K. Provide boxes where shown and where necessary for the installation and pulling of cables and wires.
- L. Install covers on junction boxes and conduit bodies after wiring and connections are completed.
- M. Install raceways perpendicular or parallel to building surfaces with boxes set plumb and square. In areas where there are no suspended ceilings, run all conduits parallel and perpendicular to building surface planes.

- N. Install conduits to prevent excessive strain or damage to conductors.
- O. Run conductors over 48 Volts in raceway, unless otherwise indicated.
- P. Where raceways are installed running parallel with flues, steam pipes, hot-water pipes, and other objects operating at high temperatures, maintain a minimum of 6 inches (150 mm) between raceway and pipe insulation or jacket.
- Q. Where raceways cross hot water and steam piping, maintain a minimum of 1-inch (25.4-mm) between raceway and pipe insulation or jacket. Install horizontal raceway runs above water and steam piping.
- R. Complete raceway installation before starting conductor installation.
- S. Support raceways and boxes as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- T. Conceal conduit within finished walls, ceilings, and raised floors, unless otherwise indicated.
- U. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
  - 1. Change from ENT to RSC, or IMC before rising above the floor.
- V. No feeders or branch circuits are to be installed in any slab, unless otherwise indicated.
- W. No branch circuits are to be installed below slab-on-grade, unless otherwise indicated. Exception: On-grade floor boxes, route raceway minimum of 6 inches below slab-on-grade.
- X. Install no more than the equivalent of three 90-degree bends and a maximum of 150 feet between pull points in any conduit run except for communications conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- Y. Join RSC and IMC with threaded couplings. Ream conduits after threading and keep each end closed.
- Z. Join EMT with the specified type of couplings. At EMT terminations, provide insulated throat, box connectors and locknuts.
- AA. Provide insulating bushing at conduit box terminations. Provide bonding clamps where grounding bushings are required.
- BB. Secure rigid conduits at cabinets and boxes with galvanized locknuts, both inside and outside.
- CC. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- DD. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- EE. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section.

Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

- FF. Install raceways to avoid moisture traps. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service raceway enters a building or structure.
  3. In damp or wet locations.
  4. Where otherwise required by NFPA 70.
- GG. Install raceways and cables as to not hinder access to ceiling space through access hatches. Maintain 36" minimum clearance and required clearance to equipment above ceiling access hatches.
- HH. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- II. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- JJ. Flexible Conduit Connections: Comply with NEMA RV 3.
1. Use minimum of 12 inches and a maximum of 72 inches (1830 mm) at final connections to equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  2. Use LFMC in damp or wet locations including mechanical equipment rooms, at motor or equipment locations at or near pumps, and when installed outdoors.
- KK. Where raceways do not terminate in a box or cabinet, install thermoplastic insulating bushings on end of raceway to protect future cabling from physical damage.
- LL. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

- MM. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- NN. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- OO. Install pull wires free of splices in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Coil and identify each end of each line with plastic tag bearing complete information as to the purpose of the raceway and the location of its other end.

### 3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Apply Sleeve and Sleeve Seal where raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies. Sleeve and Sleeve Seal materials and installation requirements are specified in Division 26 Section "Common Work Results for Electrical."

### 3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

### 3.5 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.6 CONNECTIONS

- A. Ground raceways and boxes according to Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.7 IDENTIFICATION

- A. Identify raceways and boxes as specified in Division 26 Section "Identification for Electrical Systems".

### 3.8 CLEANING

- A. On completion of raceway installation but before any cable is installed, perform the following:

1. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. On completion of box, enclosure, and cabinet installation but before any cable or wiring devices are installed, inspect interior of boxes and perform the following:
  1. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

**END OF SECTION**

## **SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Direct-buried conduit, ducts, and duct accessories.
- B. Related Sections include the following:
  - 1. Division 26 Section "Raceways and Boxes for Electrical Systems" for raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

#### **1.2 DEFINITION**

- A. Duct: an underground raceway. This term may be used interchangeably with the term raceway.
- B. Duct Bank: two or more raceways grouped together, irrespective of duct material or encasement material.
- C. ENT: Electrical Non-Metallic Tubing
- D. EPC: Electrical Polyvinyl Chloride (PVC) Conduit
- E. RMC: Rigid metal conduit.
- F. RNC: Rigid nonmetallic conduit.
- G. RSC: Rigid Steel conduit.
- H. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

#### **1.3 ACTION SUBMITTALS**

- A. Submit product data and shop drawings in accordance with Division 01 and Division 26 Section "Common Work Results for Electrical" for products specified under PART 2 - PRODUCTS.
- B. Product Data: For the following:
  - 1. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  - 2. Warning tape.
  - 3. Warning planks.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Source quality-control test reports.
- B. Field quality-control test reports.



1.5 CLOSEOUT SUBMITTALS

- A. Accurately record actual routing of duct bank on Project record documents, and submit in accordance with Division 01.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Protect conduit from corrosion and entrance of debris by storing above grade with an appropriate covering. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

**PART 2 - PRODUCTS**

2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

- A. Comply with ANSI C2.

2.2 METAL CONDUIT AND DUCTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Alflec Inc.
  - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 4. Electri-Flex Co.
  - 5. O-Z Gedney; a unit of General Signal.
  - 6. Manhattan/CDT/Cole-Flex.
  - 7. Wheatland Tube Company.
- B. RSC: Comply with ANSI C80.1 and UL 6; Galvanized rigid steel, each length with a coupling on one end and thread protector on opposite end.
- C. Fittings for RSC: Comply with UL 514B. Provide factory made threaded couplings of same material as the conduit.
  - 1. Molded thermoplastic insulating bushing at all boxes and cabinets, with locknuts inside and outside box or cabinet. In wet locations, provide watertight hubs for conduit entry into enclosures.

2. Thermoplastic insulated grounding bushing on all conduits where grounding bushings are required, with locknuts inside and outside the enclosure. In wet locations provide watertight hubs for conduit entry into enclosures.

## 2.3 NONMETALLIC CONDUIT AND DUCTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. ARNCO Corp.
  2. Beck Manufacturing.
  3. CANTEX INC.
  4. CertainTeed Corporation.
  5. Condux International, Inc.
  6. ElecSys, Inc.
  7. Electri-Flex Company.
  8. IPEX USA LLC.
  9. Lamson & Sessions.
  10. Manhattan CDT.
  11. Spiraduct/AFC Cable Systems, Inc.
- B. ENT: Comply with NEMA TC 13.
- C. RNC: Comply with NEMA TC 2 and UL 651, type EPC-40-PVC or type EPC-80-PVC as indicated.
- D. Fittings for ENT and RNC: Comply with NEMA TC 3 and UL 651; match to conduit or tubing type and material.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Division 31 Section "Site Clearing." Remove and stockpile topsoil for reapplication according to Division 31 Section "Site Clearing."

### 3.2 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Branch Circuits 600 V and Less: Provide the following, unless otherwise indicated:
  - 1. Outside building footprint: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank with warning tape.
  - 2. Under building slab, where permitted: RNC, NEMA Type EPC-40-PVC, installed in direct-buried duct bank with warning tape, minimum 12 inches below slab.
    - a. No branch circuits are to be installed below slab-on-grade, unless otherwise indicated. Exception: On-grade floor boxes, route raceway minimum of 6 inches below slab-on-grade.

### 3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:
  - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
  - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
  - 3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
  - 4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.

### 3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving", but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and re-establish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32.
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."
- E. Prepare excavation, base material installation, and compaction necessary for the specific ductbank arrangement.
- F. Verify that excavation, base material installation, and compaction is completed.
- G. Backfill trenches as specified in Division 31.

### 3.5 DUCT INSTALLATION

- A. Install ducts according to NEMA TCB 2.

- B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- C. Curves and Bends:
  - 1. Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1200 mm, both horizontally and vertically, at other locations, unless otherwise indicated.
  - 2. Where RNC is provided, use RSC elbows with corrosion resistance tape and primer for all bends.
- D. Install conduits to locate top of ductbank at depths as indicated or as required to coordinate with other portions of the Work.
- E. Apply corrosion resistance tape and primer to direct-buried or concrete-encased RSC.
- F. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- G. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical/Common Work Results for Communications/Common Work Results for Electronic Safety and Security."
- H. Stub-Ups: Use manufactured rigid steel conduit elbows and rigid steel conduit extensions for stub-ups at poles, equipment, and at building entrances through the floor. Install insulated bushings on terminations.
  - 1. Where RNC is permitted, convert to RSC prior to turning up into equipment.
  - 2. Extend conduit extensions installed in floors a minimum of 4 inches above finished floor level.
  - 3. Extend conduit extensions installed in equipment bases a minimum of 4 inches above finished base level.
  - 4. Stub-Ups to Outdoor Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit below base horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
- I. Sealing: Provide temporary caps to protect installed conduit against entrance of dirt and moisture prior to cable installation. Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- J. Pulling Cord: Install 100-lbf-test nylon cord in ducts, including spares.
- K. Direct-Buried Duct(s) and Duct Banks:
  - 1. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6 inches in nominal diameter.
  - 2. Support duct(s) on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
    - a. Provide Field-Fabricated duct separators for conduits less than 2 inches (50 mm).
    - b. Provide Pre-Manufactured duct separators for conduits 2 inches (50 mm) and larger.

- c. Required duct separators may be omitted within 2 feet (600 mm) of stub-up location.
  - 3. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
  - 4. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.
  - 5. Set elevation of bottom of duct bank below frost line.
  - 1. Minimum Space between Ducts: 3 inches between ducts for like services, and 6 inches between power and signal ducts.
  - 2. Elbows: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
    - a. Stub Ups: Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
  - 3. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving".
    - a. Place minimum 3 inches of sand as a bed for duct bank. Place sand to a minimum of 6 inches above top level of duct bank.
- L. Warning Caps: Install Cast-In-Place Caps or Manufactured Planks approximately 12 inches above direct-buried ducts and duct banks, where indicated.
- 1. Cast-In-Place Caps: Place to cover entire width of duct bank.
  - 2. Warning Planks: Place planks 24 inches o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.
- M. Warning Tape: Bury Warning Tape approximately 12 inches above ducts and duct banks, where indicated.
- 1. Align tape parallel to and within 3 inches of the centerline of duct bank.
  - 2. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

### 3.6 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.7 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Apply Sleeve and Sleeve Seal where raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, exterior walls, sub-grade walls or fire-

rated floor and wall assemblies. Sleeve and Sleeve Seal materials and installation requirements are specified in Division 26 Section "Common Work Results for Electrical."

### 3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
  - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
  - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a 6-inch-(150-mm-) long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
  - 3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

### 3.9 CLEANING

- A. On completion of installation but before any equipment or cable is installed, inspect interior and exterior surfaces and perform the following:
  - 1. Clean ducts prior to cleaning manhole or pull box.
  - 2. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
  - 3. Remove all dirt and debris and pump out the manhole or pull box so that it is free of standing water. Manholes and pull boxes shall be dry prior to equipment or cable is installed.
  - 4. Clean internal surfaces of manholes, including sump and remove foreign material.
  - 5. Repaired of damages resulting from construction after initial installation.

**END OF SECTION**

## **SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Identification for raceways.
  - 2. Identification for conductors.
  - 3. Underground-line warning tape.
  - 4. Warning labels and signs.
  - 5. Instruction signs.
  - 6. Equipment identification labels.
  - 7. Miscellaneous identification products.
- B. Related Sections include the following:
  - 1. Division 26 Section "Wiring Devices" for engraved wall plates and wiring device identification requirements.

#### **1.2 ACTION SUBMITTALS**

- A. Submit product data and shop drawings in accordance with Division 01 and Division 26 Section "Common Work Results for Electrical" for products specified under PART 2 - PRODUCTS.
- B. Product Data: For each electrical identification product indicated.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- D. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

#### **1.3 QUALITY ASSURANCE**

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.

#### **1.4 COORDINATION**

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## **PART 2 - PRODUCTS**

### **2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Color for Raceways Carrying Circuit at 600V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type, if applicable.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."

### **2.2 CONDUCTOR IDENTIFICATION MATERIALS**

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- C. Brass or Stainless Steel Wraparound Marker Labels: Cut from 0.014-inch-thick, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.
- D. Metal Tags: Brass or Stainless Steel, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking nylon tie fastener.

### **2.3 UNDERGROUND-LINE WARNING TAPE**

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
  - 1. Not less than 6 inches wide by 4 mils thick.
  - 2. Compounded for permanent direct-burial service.
  - 3. Embedded continuous metallic strip or core.
  - 4. Printed legend shall indicate type of underground line.

### **2.4 WARNING LABELS AND SIGNS**

- A. Comply with NFPA 70 and 29 CFR 1910.145.



- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
  - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for interior application.
  - 2. 1/4-inch grommets in corners for mounting.
  - 3. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs:
  - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for exterior application.
  - 2. 1/4-inch grommets in corners for mounting.
  - 3. Nominal size, 10 by 14 inches.
- E. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR ## INCHES." Verify work space required for specific project conditions with NFPA 70 and replace "##" in previous sentence with appropriate distance.
  - 3. Arc Flash Warning and Instructions: "WARNING – ARC FLASH AND SHOCK HAZARD. WEAR APPROPRIATE PPE. Determine appropriate protective clothing and personal protective equipment (PPE) for the task from NFPA 70E."

## 2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
  - 1. Engraved legend with black letters on white face.
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Adhesive, Punched, or drilled for screw mounting. Minimum letter height shall be 3/8 inch. Lettering and Background colors as indicated below:
  - a. Power Circuits:
    - 1) Normal: Match existing.

## 2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Conductor Color-Coding Key: Engraved, Laminated Acrylic, Melamine Label, or Decal-Style Label: Adhesive, Punched, or drilled for screw mounting. Minimum letter height shall be 3/8 inch. Key to describe the conductor color coding scheme used in building in accordance with NFPA 70.

## 2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F.
  - 5. Color: Black.
- D. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.
  - 1. Exterior Ferrous Metal:
    - a. Semigloss Alkyd-Enamel Finish: One finish coat(s) over a primer.
      - 1) Primer: Exterior ferrous-metal primer.
      - 2) Finish Coats: Exterior semigloss alkyd enamel.
  - 2. Exterior Zinc-Coated Metal (except Raceways):
    - a. Semigloss Alkyd-Enamel Finish: One finish coat(s) over a primer.
      - 1) Primer: Exterior zinc-coated metal primer.
      - 2) Finish Coats: Exterior semigloss alkyd enamel.
  - 3. Interior Ferrous Metal:
    - a. Semigloss Acrylic-Enamel Finish: One finish coat(s) over a primer.
      - 1) Primer: Interior ferrous-metal primer.
      - 2) Finish Coats: Interior semigloss acrylic enamel.
  - 4. Interior Zinc-Coated Metal (except Raceways):
    - a. Semigloss Acrylic-Enamel Finish: One finish coat(s) over a primer.
      - 1) Primer: Interior zinc-coated metal primer.
      - 2) Finish Coats: Interior semigloss acrylic enamel.
- E. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Conductor Color-Coding Key: Install Instructional Label denoting the conductor color-coding scheme on all panelboards.
- G. Conductor Color-Coding for Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
  - 1. Color shall be factory applied to conductors or for sizes larger than No. 8 AWG, if authorities having jurisdiction permit, field applied.
  - 2. Colors for Grounding Conductors:
    - a. Equipment Grounding Conductor: Green.
    - b. Isolated Equipment Grounding Conductor: Green with Yellow Stripe.
  - 3. Colors for 208/120-V Wye Systems:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
    - d. Grounded Conductor (Neutral): White
  - 4. Colors for 208/120-V and 240/120-V Delta Systems:
    - a. Phase A: Black.
    - b. Phase B (High Leg): Orange.
    - c. Phase C: Blue.
    - d. Grounded Conductor (Neutral): White
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.
- J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- K. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

### 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30A, and 120V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot (3-m) maximum intervals.
- B. Power-Circuit Conductor Identification, 600V or Less: Identify source and circuit number of each ungrounded conductor or set of conductors. For single conductor cables, identify phase in addition to the above.

1. For conductors in pull and junction boxes, device boxes, and within 6-inches (153 mm) of termination use pre-printed marker tape.
  2. For conductors in vaults, manholes, hand holes and pull and junction boxes located in damp or wet locations use brass or stainless steel wraparound marker labels.
- C. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
  2. Arc Flash Warning Labels: Apply label to door or cover at all access point of equipment including, but not limited to, the following:
    - a. Panelboards.  
Available Fault Current Field Marking: Apply label to cover of new service equipment enclosure with the date in which the fault current was calculated and the available fault current as indicated on Drawings.  
Table 1 below lists a typical example of label format, coordinate project specific requirements with Drawings.

Table 1 (Example Only)

MAX. AVAILABLE FAULT: XX,XXA DATE: X/X/XX
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- E. Junction Boxes and Pull Boxes: Identify voltage, source, and circuit number(s) on cover of pull and junction boxes with hand-written legible block lettering using black permanent marking pen.
- F. Instruction Signs:
1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual.
1. Labeling Instructions:
    - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where 3 lines of text or more are required, use label height as required to accommodate 3/8-inch-high letters.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label drilled and attached with corrosion-resistant screws.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor per ANSI A13.1.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  2. Distribution Equipment with Overcurrent Protective Devices to be labeled:
    - a. Provide for each of the following and any other similar equipment furnished under this Division identification as to its given name, voltage, origination of service,

branch, and amps rated interrupting. Table 2 below lists typical examples of label format, coordinate project specific requirements with Drawings:

1) Panelboards.

Table 2 (Examples Only)

EMERGENCY SYSTEM 'EMSA' 480Y/277V FED FROM 'GEN-1' RATED INTERRUPTING: XX,XXXA	NORMAL '1DPHA' 480Y/277V FED FROM 'MSA' RATED INTERRUPTING: XX,XXXA	LIFE SAFETY BRANCH '1LSHA' 480Y/277V FED FROM 'DPLSHA' RATED INTERRUPTING: XX,XXXA
EQUIPMENT SYSTEM '1EQLA' 208Y/120V FED FROM 'T1EQLA' RATED INTERRUPTING: XX,XXXA	CRITICAL BRANCH '1CRHA' 480Y/277V FED FROM 'ATS-CR' RATED INTERRUPTING: XX,XXXA	NON-ESSENTIAL '1DPCH-N' 480Y/277V FED FROM 'ATS-N' RATED INTERRUPTING: XX,XXXA
NORMAL 'CHP-1' 480Y/277V FED FROM 'MCC-1' RATED INTERRUPTING: XX,XXXA	NORMAL 'AHU-1' 480Y/277V FED FROM '1DPHA' RATED INTERRUPTING: XX,XXXA	EQUIPMENT SYSTEM 'HWP-1' 480Y/277V FED FROM 'CPEQHA' RATED INTERRUPTING: XX,XXXA

3. Distribution Equipment without Overcurrent Protective Devices to be labeled:
  - a. Provide for each of the following and any other similar equipment furnished under this Division identification as to its given name, voltage, origination of service, and branch. Table 3 below lists typical examples of label format, coordinate project specific requirements with Drawings:
    - 1) Electrical cabinets, and enclosures.

Table 3 (Examples Only)

CRITICAL BRANCH 'T2CLA' 75 KVA, 480V to 208Y/120V FED FROM '2CHA' FEEDS '2CRLA'	EQUIPMENT SYSTEM 'ATS EQ' 480Y/277V FED FROM 'MSA' NORMAL FED FROM 'EMSA' EMERGENCY FEEDS '1EQHA'	OPTIONAL STANDBY SYSTEM 'ATS SS' 480Y/277V FED FROM 'MSA' NORMAL FED FROM 'EMSA' EMERGENCY FEEDS '1SSHA'
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4. Provide for each feeder overcurrent protective device in each panelboard, and any other similar equipment furnished under this Division, identification as to the specific load that it serves.

**END OF SECTION**

## **SECTION 262416 - PANELBOARDS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes service and distribution panelboards rated 600 V and less, including the following:
  - 1. Lighting and appliance branch-circuit panelboards.

#### **1.2 DEFINITIONS**

- A. DPM: Multifunction Digital-Metering Monitor
- B. EMI: Electromagnetic interference.
- C. GFCI: Ground-fault circuit interrupter.
- D. GFEP: Ground-fault equipment protection.
- E. RFI: Radio-frequency interference.
- F. RMS: Root mean square.
- G. SPDT: Single pole, double throw.

#### **1.3 ACTION SUBMITTALS**

- A. Submit product data and shop drawings in accordance with Division 01 and Division 26 Section "Common Work Results for Electrical" for products specified under PART 2 - PRODUCTS.
- B. Product Data: For each type of panelboard, overcurrent protection device, accessory, and related component, include the following:
  - 1. Manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
  - 2. Rated capacities, features, operating characteristics, furnished specialties, factory settings, accessories and time-current characteristic curves for individual relays and overcurrent protective devices.
    - a. Time-current curves for each type of overcurrent protection device. Include hardcopy of characteristic curve and TCC Number for use with Power Tools by SKM Systems Analysis, Inc. Indicate available setting points and selectable ranges for each type of adjustable overcurrent protection device.
- C. Shop Drawings: For each panelboard and related equipment, include the following:
  - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show method of field assembly and location and size of each field connection. Include the following:
    - a. Tabulation of installed devices with features and ratings.
    - b. Enclosure types and details.

- c. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
- d. Bus configuration with size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses.
- e. One-line diagram.
- f. Bus current and voltage ratings.
- g. Short-time and short-circuit current rating of equipment assembly.
- h. Feeder entry locations and lug configuration.
- i. Elevation drawing showing locations for anchor bolts.
- j. Nameplate legends.
2. Wiring Diagrams: For each type of panelboard and related equipment, include the following:
  - a. Power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Submit Coordination Drawings in accordance with Division 26 Section "Common Work Results for Electrical" for each location where panelboards are included in the Work.
- B. Panelboard Directories: For installation in panelboards.
- C. Field quality-control Test Method and Procedure: List of procedures to be used during functional and operations sequence testing. Method of Procedure should include but not be limited to the following:
  1. Tabulation of Testing Equipment and PPE required for tests.
  2. Schedule of Shutdowns required.
  3. Manufacturer's Recommended Pre-Start Checklists for the following:
    - a. Overcurrent Protection Devices
  4. Step-by-Step Testing Operations and Criteria for tests listed in Part 3 Paragraph "Field quality-control".
- D. Field quality-control test reports including the following:
  1. Test results that comply with requirements.
  2. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electrical equipment, accessories and components to be included in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  1. Manufacturer's routine maintenance requirements for panelboard and all installed components.
  2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  3. Time-current curves, including selectable ranges for each type of relay and overcurrent protective device. Include directory listing each adjustable breaker included in the Work and their final set points.
  4. Manufacturer's sample system checklists and log sheets.

## 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer, unless otherwise indicated.
  - 1. Breaker Manufacturer: Manufacturer for breakers shall be the same as the manufacturer of other breakers proposed for other portions of the Work.
  - 2. Breaker Manufacturer for installation into existing panelboard: Manufacturer for breakers shall match the manufacturer of the existing equipment. For discontinued equipment, breaker shall be compatible and listed for installation within existing equipment.
- B. Product Options: Drawings indicate spatial allocation for panelboards, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum spatial allocation. Refer to Division 01 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C2.
- E. Comply with NFPA 70.
- F. Comply with NEMA PB 1 "Panelboards".

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Prepare equipment for shipment.
  - 1. Provide suitable crating, blocking, and supports so equipment will withstand expected domestic shipping and handling shocks and vibration.
  - 2. Weatherproof equipment for shipment. Close connection openings to prevent entrance of foreign material during shipment and storage.
- B. Installation Pathway: Coordinate delivery of equipment to allow movement into designated space.
  - 1. Deliver in shipping splits in sizes that can be moved past obstructions in delivery path.
  - 2. Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving equipment into place.
- C. Store equipment indoors in clean dry space with uniform temperature in accordance with manufacturer's requirements to prevent condensation. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- D. Handle equipment components according to manufacturer's written instructions. Use factory-installed lifting provisions.
- E. Handle panelboards according to NEMA PB 1.1 and NECA 407.

## 1.8 PROJECT CONDITIONS

- A. Interruption of Existing Electric Service: Comply with requirements defined in Division 26 Section "Common Work Results for Electrical".



- B. Field Measurements: Indicate field measurements on Shop Drawings where equipment is proposed for installation in existing spaces.
- C. Environmental Limitations: Rate equipment for continuous operation at indicated ampere ratings for the following conditions:
  - 1. Ambient Temperature for Circuit Breakers: Not less than 23 deg F and not exceeding 122 deg F.
  - 2. Altitude: Not exceeding 6600 feet (2000 m).

## 1.9 COORDINATION

- A. Coordinate layout and installation of panelboard and components with other construction that penetrates floors, ceilings or walls or are supported by them, including but not limited to conduit, piping, other electrical equipment, light fixtures, HVAC equipment, fire-suppression-system components and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cutler-Hammer, Inc.; Eaton Corporation.
  - 2. General Electric Co.; Consumer and Industrial Div.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; Schneider Electric.

### 2.2 RATINGS

- A. Suitable for application in 3-phase, 60-Hz, solidly grounded-neutral system, unless otherwise indicated.
- B. Nominal System Voltage: As indicated on the Drawings.
- C. Main-Bus: Amperage as indicated on the Drawings. Provide continuous rating across entire length of main-bus.
- D. Short-Time and Short-Circuit Current: Match rating of highest-rated overcurrent protective device in panelboard assembly.
  - 1. Available Short-Circuit Current: As indicated on the Drawings.

### 2.3 MANUFACTURED UNIT FABRICATION

- A. Mounting height of breakers shall be in accordance with NFPA 70 requirements. Fabrication of equipment shall take housekeeping pad dimension into account in determining height of top breaker in all sections. Refer to Division 26 Section "Hangers and Supports for Electrical Systems" for housekeeping pad specifications.

- B. Enclosures: Flush- and surface-mounted cabinets, as indicated. NEMA PB 1.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
  - 2. Front Cover: Provide the following, unless otherwise indicated:
    - a. Hinged Front Cover: Door-in-Door construction with entire front trim hinged to box and with standard door within hinged trim cover to access device handles.
  - 3. Enclosure Finish for Outdoor Units: Factory-applied finish in manufacturer's standard ANSI Gray enamel over corrosion-resistant treatment or rust-inhibiting primer coat, undersurfaces treated with corrosion-resistant undercoating.
  - 4. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard ANSI Gray enamel over corrosion-resistant treatment or rust-inhibiting primer coat.
- C. Buses and Connections: Three phase, four wire, unless otherwise indicated.
  - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, with copper feeder circuit-breaker line connections.
    - a. Lugs: Mechanical style, one or two hole style to suit conditions, suitable for quantity and size of conductor. UL 486 B listed, dual rated and marked for use with copper- or aluminum conductors to suit project conditions.
  - 2. Ground Bus: Hard-drawn copper of 98 percent conductivity, Adequate for feeder and branch-circuit equipment ground conductors; bonded to box. Equipped with mechanical connectors for feeder and branch-circuit ground conductors.
  - 3. Neutral Buses: 100 percent of the ampacity of phase buses, unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables.
  - 4. Bus Size: Comply with UL 489, including allowance for spare circuit breakers and spaces for future circuit breakers. Include bus to extend the full length of vertical sections.
  - 5. Support and Brace Buses for indicated short-circuit currents.
  - 6. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of panelboard section.
  - 7. Conductor Connectors: Suitable for use with conductor material; dual rated for use with copper- or aluminum conductors; marked AL7CU for 75 degrees C rated circuits.
  - 8. Feed-Through Lugs where indicated on Drawings: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  - 9. Isolated Equipment Ground Bus, where indicated on Drawings: Adequate for branch-circuit equipment ground conductors; insulated from box.
  - 10. Extra-Capacity Neutral Bus, where indicated on Drawings: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
  - 11. Extra-Capacity Neutral Lugs: Where Extra-Capacity Neutral Bus is indicated on Drawings, provided lugs rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- E. Future Device Provision: Equip compartments with unused space with mounting brackets, bus connections, and necessary appurtenances required for future installation of devices. Provide bussing for full length of enclosure section.
- F. LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS
  - 1. Door Hardware: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
  - 2. Main Overcurrent Protection Device Type: Provide overcurrent device as follows, unless otherwise indicated: Circuit breaker.

- a. Main OCPD rated less than 250 Amps: Adjustable Instantaneous-Trip Circuit Breakers.
3. Branch Overcurrent Protection Device Type: Provide overcurrent device as follows, unless otherwise indicated: Circuit breaker.
  - a. Branch OCPD: Thermal-Magnetic; Bolt-on circuit breakers replaceable without disturbing adjacent units.

## 2.4 OVERCURRENT PROTECTIVE DEVICES

- A. Series-rated devices are not permitted.
- B. Molded-Case Circuit Breaker Requirements: UL 489, NEMA AB 3, with interrupting capacity rating to meet available fault current.
  1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity. Provide as indicated and as required by NFPA 70 for personnel protection.
  4. GFEP Circuit Breakers: Single- and two-pole configurations with 30-mA trip sensitivity. Provide as indicated and as required by NFPA 70 for equipment protection.
  5. AFCI Circuit Breakers: Single- and two-pole configurations. Provide as indicated and as required by NFPA 70 for personnel protection.
- C. Molded-Case Circuit-Breaker Features: Standard frame sizes, trip ratings, and number of poles. Provide the following features for all included in the Work:
  1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material; UL 486 B listed, dual rated and marked for use with copper- or aluminum load-side conductors.
  2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
  3. Lock-Out Tag Provisions: For installing at least three Lock-Out tags on each circuit breaker to secure the breaker and prevent movement mechanism.
- D. Circuit-Breaker Accessories: Standard frame sizes, trip ratings, and number of poles. Provide the following accessories where indicated:
  1. Ground-Fault Protection: Provide integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - a. Ground fault indicator alarm to provide visual alarm status.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces where equipment will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance.
- B. Examine roughing-in of conduits to verify the following:
  1. Wiring entries comply with layout requirements.

2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.
- C. Verify that ground connections are in place and that requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with NECA 407, "Recommended Practice for the Installing and Maintaining Panelboards" as published by the National Electrical Contractors Association.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards and components once unit is secured in place.
- D. Comply with mounting and support requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Mount top of trim 74 inches above finished floor, unless otherwise indicated.
- F. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- G. Install overcurrent protective devices, controllers, and instrumentation.
- H. Install filler plates in unused spaces.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- J. For Recessed Panels: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- K. Close unused conduit opening or other unused holes in sides of box with proper mating blank-off plates.
- L. Do not use gutters of panelboards as raceways for routing feeder conductors from bottom entrance to top-feed lugs or vice versa; an external gutter or conduit shall be used for this purpose.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components and provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Equipment Identification Nameplates: Label each panelboard with engraved Equipment Identification Label as specified in Division 26 Section "Identification for Electrical Systems."

- C. Distribution Panelboard Feeder OCPD Labels: Label each OCPD with nameplate that indicates the device it feeds using engraved Equipment Identification Label as specified in Division 26 Section "Identification for Electrical Systems."
- D. Panelboard Directory: Create a directory to indicate name/descriptions of installed circuit loads, including final room numbers. Obtain final room numbers from Owner. Obtain approval before installing within clear plastic pocket inside panelboard cover. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- E. Diagram and Instructions:
  - 1. Frame and mount the following items in clear acrylic plastic holder on the front of panelboard.
    - a. Operating Instructions: Printed basic instructions for panelboard, including control and emergency procedures where applicable.
  - 2. Storage for Maintenance Manual: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

### 3.4 CONNECTIONS

- A. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
  - 3. Assist in field testing of equipment including pre-testing and adjusting of equipment and components.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Inspect panelboard installation, including wiring, components, connections, and equipment. Test and adjust components and equipment.
  - 2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.
  - 3. After installing panelboard but before equipment is energized, verify that grounding system at panelboard tests to specified value or better.
  - 4. Perform each electrical test and visual and mechanical inspection stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:
    - a. Section 7.6 for Circuit Breakers
    - b. Section 7.13 for Grounding Systems
    - c. Section 7.14 for Ground-Fault Protection Systems; where applicable.
  - 5. Infrared Scanning: Perform Thermographic Survey in accordance with NETA ATS, Section 9.0.

- a. Initial Infrared Scanning: Within 60 Days after Substantial Completion, perform an infrared scan of each panelboard. Open or remove doors and covers so connections are accessible to portable scanner.
  - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
  - c. Instruments, Equipment:
    - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- 6. Complete installation and startup checks according to manufacturer's written instructions.
- C. Correct Deficiencies, Retest and Report:
  - 1. Correct unsatisfactory conditions, and retest to demonstrate compliance; replace conductors, units, and devices as required to bring system into compliance.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Prepare a report that identifies switchboards, units, conductors and devices checked and describes results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.
- D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### 3.6 CLEANING

- A. Clean components according to manufacturer's written instructions.
- B. Prior to installation of front trim and cover plates inspect interior surfaces and perform the following:
  - 1. Remove paint splatters and other spots.
  - 2. Vacuum dirt and debris; do not use compressed air to assist in cleaning.
- C. On completion of front trim and cover installation, inspect exterior surfaces and perform the following:
  - 1. Remove paint splatters and other spots.
  - 2. Remove all temporary markings and labels.
  - 3. Vacuum dirt and debris; do not use compressed air to assist in cleaning.
  - 4. Repair exposed surfaces to match original finish.

### 3.7 PROTECTION

- A. Temporary Heating: Maintain a clean dry space with uniform temperature in accordance with manufacturer's requirements to prevent condensation. Apply temporary heating as required.
- B. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

### 3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's management and maintenance personnel to adjust, operate, and maintain panelboards, overcurrent protective

devices, instrumentation, and accessories. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION**

## **SECTION 26 56 00 – EXTERIOR LIGHTING (“R” prefix only)**

### **PART 1 - PART 1- GENERAL**

#### **1.1 DESCRIPTION**

- A. Provide lighting fixtures in accordance with the Contract Documents.

#### **1.2 CONTRACT DOCUMENTS**

- A. All work of this Section shall comply with the requirements of the Conditions of the Contract (General, Supplementary, and Special), with all Sections of Division 1 -General Requirements, with the Drawings, and with all other Contract Documents.

#### **1.3 WORK INCLUDED**

- A. Furnish and install a lighting fixture of the type indicated by letter at each location shown on the drawings.
- B. Furnish and install lamps for all lighting fixtures (furnished as part of the electrical work).
- C. All materials, accessories, and any other equipment necessary for the complete and proper installation of all lighting fixtures included in this Contract shall be furnished by the Contractor.
- D. Fixtures shall be manufactured in strict accordance with the Contract Drawings and Specifications.
- E. Specifications and scale drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work.
- F. Minor details, not usually indicated on the drawings nor specified, but that are necessary for the proper execution and completion of the fixtures, shall be included, the same as if they were herein specified or indicated on the drawings.
- G. The Owner shall not be held responsible for the omission or absence of any detail, construction feature, etc. which may be required in the production of the fixtures. The responsibility of accurately fabricating the fixtures to the fulfillment of this specification rests with the Contractor.

#### **1.4 RELATED WORK SPECIFIED ELSEWHERE**

- A. Related sections of electrical work: See sections of Division 26.



1.5 SUBMITTALS

- A. Shop Drawings shall clearly indicate the Contract Drawing number of fixture details used as reference in the development of the shop drawings and the names of the job, architect and lighting consultant. Shop drawings shall be complete submissions for approval and maintenance and, where applicable, shall include the wiring diagram, scale plans, and details showing the method of installation of lampholders, lamps, reflectors, transformers and secondary feeds as well as complete bill of materials. Where applicable, verify field dimensions and include them on shop drawings showing exact locations of lampholders, and lamp shapes and lengths. Provide sepia copies of approved shop drawings for owner's use in maintenance and lamp replacement.
- B. The Contractor shall coordinate all his lighting fixture drawings with the drawings and details of the Architectural, Structural, Electrical, Mechanical, and other related trades to assure a perfect and efficient installation.
- C. No variation from the general arrangement and details indicated on the drawings shall be made on the shop drawings unless required to suit the actual conditions on the premises, and then only with the written acceptance of the Architect. All variations must be clearly marked as such on drawings submitted for approval.
- D. Catalogue Cuts lacking sufficient detail to indicate compliance with contract documents will not be acceptable.
- E. Shop drawings shall be submitted in reproducible form for all lighting fixtures and shall be received no later than sixty days after award of Contract.
- F. Review of shop drawings or samples does not waive contract requirements.
- G. Where indicated on the fixture schedule and contract drawings, supply complete photometric data for the fixture, including optical performance rendered by independent testing laboratory developed according to methods of the Illuminating Engineering Society of North America as follows:
  - 1. Coefficients of utilization
  - 2. Luminance table with data presented numerically, showing maximum luminance of the fixture at the shielding angles. Readings should be taken both crosswise and lengthwise in the case of fluorescent fixtures or fixtures with an asymmetric distribution
  - 3. Candela distribution data, presented graphically and numerically, in 5° increments (5°, 10°, 15°, etc.). Data developed for up and down quadrants normal, parallel, and at 22-1/2°, 45°, 67-1/2° to lamps if light output is asymmetric
  - 4. Zonal lumens stated numerically in 10° increments (5°, 15°, etc.) as above
  - 5. Area and roadway fixtures shall also include isocandela charts and IES roadway distribution classification.
- H. Supply photometric data for any fixture offered in substitution for a specified fixture.
- I. The Contractor shall be responsible for obtaining from his supplying lighting manufacturers, for each type of lighting fixture, a recommended maintenance manual including:
  - 1. Tools required

2. Types of cleaners to be used
3. Replacement parts identification lists
4. Final, as-built shop drawings

#### 1.6 SAMPLES

- A. After shop drawing review, and prior to release for manufacturing, the Contractor shall furnish one sample of each fixture on the fixture schedule and contract drawings for which sample requirement is noted.
- B. Samples shall be complete with specified lamp(s), ready for hanging, energizing, and examining, and shall be shipped, prepaid by Contractor, to the Lighting Consultant, or as otherwise advised.
- C. Two weeks from date received shall be allowed for thorough examination of the samples by the Lighting Consultant.
- D. Samples are not returnable, nor included in quantities listed for a project.
- E. Samples must be actual working unit of materials to be supplied.

#### 1.7 REFERENCE STANDARDS

- A. Materials and installation shall be in accordance with the latest revision of the National Electrical Code and any applicable Federal, State, and local codes and regulations.
- B. All fixtures and ballasts shall be manufactured in strict accordance with the appropriate and current requirements of the National Electric Code as verified by Underwriters' Laboratories, Inc., or other testing agency as acceptable to local code authorities. Such a listing shall be provided for each fixture type, and the appropriate label or labels shall be affixed to each fixture in a position concealing it from normal view.

#### 1.8 QUALIFICATION OF BIDDERS

- A. Manufacturers listed in the fixture schedule shall be assumed capable of supplying the listed fixtures unless exceptions are set forth in their quotations. Any such exceptions shall immediately be brought to the attention of the Architect and the Lighting Consultant. Manufacturers not listed must be pre-qualified to bid as follows:
- B. Manufacturer shall have not less than five years of experience in design and manufacture of lighting fixtures of the type and quality shown. Pre-qualification submissions must include a list of completed projects and dated catalogue pages or drawings indicating length of experience.
- C. Manufacturer shall also submit a prototype sample of each fixture for review by the Architect. Prototype samples shall be sufficiently detailed and operational to allow evaluation of compliance with the salient features of the specification. Preliminary design or shop drawings shall not be accepted in place of prototype samples.
- D. The architect shall be the sole judge in determining whether the prototype sample complies with the specifications, and shall reserve the right to disqualify any bidders.

#### 1.9 QUALITY ASSURANCE

- A. Materials, equipment and tools, as well as workmanship provided under this Section shall conform to the highest commercial standard as specified and as indicated on drawings.

#### 1.10 WARRANTY

- A. The Contractor shall warrant the fixture, its finishes, and all of its component parts, except ballasts, to be free from defects for a period of one year from date of Substantial Completion if operated within rated voltage range. Replacement of faulty materials and the cost of labor required to make the replacement shall be the responsibility of the Contractor. Ballasts shall be warranted for three years

#### 1.11 BASE BID MANUFACTURERS

- A. The Contractor shall base their bid for lighting fixtures on those manufacturers as specified.
- B. Specification of alternate manufacturers, identified by means of manufacturers' names and catalog numbers, is to establish basic features and performance standards. Any substitutions must meet or exceed these standards.

- C. Within sixty days of placement of order, Contractor must furnish independent photometric tests and samples for all alternative fixtures. If fixture fails to comply with specification requirements at that time, Contractor shall reimburse the Owner for the Architect's and Lighting Designer's fees for time spent evaluating alternate fixtures, and shall furnish the originally specified fixture at no additional cost to the Owner and with no delay to the project.

#### 1.12 EXTRA MATERIAL/ATTIC STOCK

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and listing corresponding 'R' fixture types.
- B. Fixture types R01, R03, R04, R04-1, R06, R07, R08, R09, R10, R11: Provide 20% of each type and rating installed. Furnish at least one of each type.
- C. Fixture types R02, R12: Furnish at least one of each type.
- D. Fixture type R05: Provide 1 additional fixture for each nominal or custom length fixture in the project.
- E. Power Supplies: 10% of each type and rating installed. Furnish at least one of each type.
- F. Globes, Guards, Louvers: 10% of each type and rating installed. Furnish at least one of each type.

### PART 2 - PART 2- PRODUCTS

#### 2.1 FIXTURE CONSTRUCTION (GENERAL)

- A. All materials, accessories, and other related fixture parts shall be new and free from defects which in any manner may impair their character, appearance, strength, durability and function, and effectively protected from any damage or injury from the time of fabrication to the time of delivery and until final acceptance of the work.
- B. Fabricate fixture enclosures with a minimum of #20 gauge (0.0359 inch thick) cold rolled sheet steel. Enclosures may be constructed of other metals, provided they are equivalent in mechanical strength and acceptable for the purpose. Fabricate lighting fixtures to be finished in vitreous porcelain enamel from a minimum of #20 gauge enameling steel.
- C. All sheet metal work shall be free from tool marks and dents, and shall have accurate angles bent as sharp as compatible with the gauges of the required metal. All intersections and joints shall be formed true, of adequate strength and structural rigidity to prevent any distortion after assembly.

- D. Housings shall be so constructed that all electrical components are easily accessible and replaceable without removing fixtures from their mountings, or disassembly of adjacent construction.
- E. All castings shall be exact replicas of the approved patterns and shall be free of sand pits, blemishes, scales and rust, and shall be smoothly finished. Tolerance shall be provided for any shrinkage of the metal castings in order that the finished castings will accurately fit in their designated locations.
- F. All lamp sockets in lighting fixtures shall be suitable for the indicated lamps and shall be set so that lamps are positioned in optically correct relation to all lighting fixture components. If adjustable socket positions are provided, socket should be preset in factory for lamp specified. If different socket positions are specified for same fixture, sockets shall be preset for each type, and cartons marked accordingly.
- G. All fixtures shall be completely wired at the factory.
- H. If ceiling system requires, each recessed and semi-recessed fixture shall be furnished with a mounting frame or ring compatible with the ceiling in which they are to be installed. The frames and rings shall be one piece or constructed with electrically-welded butt joints, and of sufficient size and strength to sustain the weight of the fixture.
- I. Light leaks between ceiling trims of recessed lighting equipment and the ceilings will not be tolerated. If fixture is used in partially transparent ceiling, light leaks above the ceiling line will not be tolerated.
- J. Yokes, brackets and supplementary supporting members needed to mount lighting fixtures to carrier channels or other suitable ceiling members shall be furnished and installed by the Contractor.
- K. Fixtures for use outdoors or in areas designated as damp locations shall be suitably gasketed to prevent the entrance of moisture. Provide approved wire mesh screens for ventilation openings. All dissimilar metal materials shall be separated by a non-conductive material to prevent galvanic action.
- L. For steel and aluminum fixtures, all screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel fixtures, all hardware shall be stainless steel. For bronze fixtures, all hardware shall be stainless steel or bronze.
- M. All fixtures and ballasts must operate within the temperature limits of their design and as specified by Underwriters' Laboratories, Inc. in the applications and mounting conditions herein specified.
- N. Each lighting fixture which has a beam angle adjustment shall have reliable angle locking devices for all adjustable axes.
- O. Each lighting fixture which has a lamp with an oval shape beam pattern shall contain lamp orientation locking devices to insure that beam orientation is not disturbed during future lamp replacement or cleaning.
- P. Each lighting fixture which has a spread lens shall contain lens orientation locking devices to insure that lens orientation is not disturbed during future lamp replacement or cleaning.

- Q. All materials, accessories, and any other equipment necessary for the complete and proper installation of all lighting fixtures included in this Contract shall be furnished by the Contractor.
- R. Welding shall be done with electrodes and/or methods recommended by the manufacturers of the metals being welded. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth. All welds on or behind surfaces which will be exposed to view shall be done so that finished surface will be free of imperfections such as pits, runs, splatter, cracks, warping, dimpling, depressions or other forms of distortion or discoloration. Remove weld spatter and welding oxides from all welded surfaces.
- S. Extruded aluminum frame and trim shall be rigid and manufactured from quality aluminum without blemish in the installed product. Mitre cuts shall be accurate, joints shall be flush and without burrs and cuts alignment maintained with the light fixture located in its final position.

## 2.2 REFLECTORS & TRIMS

- A. Reflectors, reflector cones and visible trim of all lighting fixtures shall not be installed until completion of plastering, ceiling tile work, painting and general cleanup. They shall be carefully handled to avoid scratching or fingerprinting and shall be, at the time of acceptance by the Owner, completely clean.
- B. All Alzak parabolic cones shall be guaranteed against discoloration for a minimum of ten years, and, in the event of premature discoloration, shall be replaced by the manufacturer, including both materials and the cost of labor.
- C. Aluminum reflectors shall be finished specular, semi-specular, or diffuse as required and shall meet or exceed Alzak specifications. Minimum requirements of reflector finishes for interior and exterior service shall be as follows:

Description of Service	Minimum Weight of Coating, mg per sq in	Min. Reflectance %, Specular/Diffuse
Normal interior commercial service	5.0	83/75
General interior industrial and exterior work - reflector protected by glass covering	7.5	82/73
Exterior industrial and commercial work - reflector not protected	10.0	78/75

Exterior marine  
service - reflector not  
protected

13.0

78/65

- D. Reflectors, reflector cones and visible trim of all lighting fixtures shall be turned over to the Owner clean and free of scratches and fingerprints.

## 2.3 LENSES

- A. Plastic for lenses and diffusers shall be formed of colorless 100% virgin acrylic as manufactured by Rohm & Haas, DuPont or equally acceptable manufacturers. The quality of the raw material must meet American Society of Testing Materials (ASTM) standards as tested by an independent test laboratory. Acrylic plastic lenses and diffusers shall be properly cast, molded or extruded as specified, and shall remain free of any dimensional instability, discoloration, embrittlement, or loss of light transmittance for at least 15 years.
- B. Glass used for lenses, refractors, and diffusers in incandescent lighting fixtures shall be tempered for high impact and heat resistance; the glass shall be crystal clear in quality with a transmittance of not less than 88%. For exterior fixtures use tempered Borosilicate glass, Corning #7740 or equal. For fixtures directly exposed to the elements and aimed above the horizontal, use Corning Vycor glass or equal.
- C. Where optical lenses are used, they shall be free from spherical and chromatic aberrations and other imperfections which may hinder the functional performance of the lenses.
- D. All lenses, louvers, or other light diffusing elements shall be removable, but positively held so that hinging or other normal motion will not cause them to drop out.
- E. All lenses shall be turned over to the Owner clean and free of dust.

## 2.4 LAMP HOLDERS

- A. Incandescent:
1. Body: porcelain
  2. Screw Shell: nickel-plated brass, pre-lubricated with silicone compound.
- B. Fluorescent
1. Body: white urea plastic
  2. Contacts: silver-plated phosphor bronze.

## 2.5 FINISHES

- A. Painted Surfaces shall be of synthetic enamel, with acrylic, alkyd, epoxy, polyester, or polyurethane base, light stabilized, baked on at 350° Fahrenheit minimum, catalytically or photochemically polymerized after application.
- B. White finishes shall be of minimum of 85% reflectance.
- C. Ceiling opening frames shall either be manufactured of non-ferrous metal, or be suitably rustproofed after fabrication.
- D. Unless otherwise noted, finishes shall be as selected by the architect.
- E. Except for stainless steel give ferrous metal surfaces a five stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.
- F. Unpainted non-reflecting surfaces shall be satin finished and coated with a baked-on clear lacquer to preserve the surface. Where aluminum surfaces are treated with an anodic process, the clear lacquer coating may be omitted.
- G. Unpainted Aluminum Surfaces
  - 1. Finish interior aluminum trims with an anodized coating of not less than 7 mg. per square inch, of a color and surface finish as selected by the Architect.
  - 2. Finish exterior aluminum and aluminum trims with an anodized coating of not less than 35 mg. per square inch, of a color and surface finish as selected by the architect.
- H. Apply porcelain enamel finishes smoothly. Finish shall be not less than .0075 in. thick of non-yellowing, white, vitreous porcelain enamel with a reflectance of not less than 85%.

## 2.6 LAMPS

- A. Unless otherwise specified, lamps shall be manufactured by: General Electric, Philips or Osram-Sylvania.
- B. All lamps of a given type shall be supplied by the same manufacturer.
- C. If a specific manufacturer is noted in the schedule, only that manufacturer shall be acceptable.
- D. Lamps shall not be operated, other than for initial testing, prior to final inspection.

## 2.7 INCANDESCENT LIGHTING FIXTURES



1. Incandescent lighting fixtures shall be listed and labeled by Underwriters' Laboratories, Inc. or other testing agency acceptable to local code authorities, for installation in fireproof or non-fireproof construction, damp or wet locations, as required.
2. Aluminum reflectors shall be Alzak (finish as selected) or as authorized, and not less than 0.057 inch thick unless specified otherwise.
3. Lampholders shall be UL listed, and be heavy duty type constructed of high grade porcelain. Provide medium base sockets for lamps to and including 250 watts and mogul based sockets from 300 watts up to 1500 watts (rated for 1500 watts, 600 volt service) unless specified otherwise.
4. Incandescent lighting fixtures utilizing tungsten gen sources shall be designed and constructed so that lamp seal temperatures do not exceed 350°C at an ambient of 25°C when tested in accordance with UL Standard #57 and shall maintain an operating bulb wall temperature of approximately 600°C and not less than 250°C.
5. Lead wires for fixtures utilizing tungsten halogen sources shall be rated for not less than 200°C. operation, but shall be rated for 250°C if temperature warrants.
6. Temperature on reflectors shall not exceed 205°C at any point.
7. All fixtures supplied for recessing in suspended ceilings shall be supplied with pre-wired junction boxes.

## 2.8 LIGHT EMITTING DIODE

- A. All LEDs used in the LED fixture shall be high brightness and proven quality from the same Diode manufacturer which are binned and shipped at the same time.
- B. Lighting Manufacturer of LED systems shall utilize an advanced production LED binning process within range of CCT and Chromaticity per acceptable industrial standard, i.e, ANSI C78.377-2008 or 2-steps of MacAdam Ellipse to maintain color consistency.
- C. Color temperature for white LEDs should be specified Color Temperature with a Color Rendering Index (CRI) of 80 or higher and Correlated Color Tempertaure (CCT) of +/- 150K or per ANSI standard.
- D. LED fixture and power/data supply shall be UL listed and CE certified for class 1 or class 2 wiring.
- E. The LED fixture shall be operated at constant and carefully regulated current levels. LEDs shall not be overdriven beyond their specified nominal voltage and current.
- F. Operating temperature not to exceed range set by Manufacturer to avoid premature failure and to obtain expected life. LED occupied space to be conditioned if necessary.
- G. LED fixture housing shall be designed to transfer heat from the LED board to the outside environment.
- H. All LED fixtures (100% of each lot) shall undergo a minimum eight-hour burn-in test during manufacturing.

- I. Lumen maintenance and Lumen depreciation expected life time estimation shall be provided by manufacturer, tested in accordance with IESNA LM 80-08 and TM-21.
- J. High power LED fixture shall be thermally protected using one or more of the following thermal management techniques: metal core board, gap pad, and/or internal monitoring firmware.
- K. Constant data transmission rates shall be employed, resulting in the output being independent of distance of cable between power supply and light source within the specified length.
- L. LED dimming type must be matched with driver manufacturer's recommendations. Drivers must not over-drive the LEDs beyond LED manufacturer recommendations and must provide uniform, smooth, full-range dimming. LEDs must maintain consistent brightness and color throughout the dimming range. Drivers must allow for manual fine-tuning to assure that LEDs remain consistent in appearance from those controlled on one driver to the next.
- M. All hardwired connections to LED fixtures shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
- N. All LED fixtures and power/data supplies shall be tested to ensure compatibility.
- O. Power/data supply outputs shall have current limiting protection and power factor correction, and provide miswiring protection.
- P. Power/data supply shall provide connections that are conduit-ready or clamp-style connections for the low-voltage wiring.
- Q. Power/data supply shall come with a housing that meets a minimum IP20 rating for dry location installation.
- R. For wet and damp use, LED-based fixture itself shall be sealed, rated, and tested for appropriate environmental conditions, not accomplished by using an additional housing or enclosure.
- S. Each LED module within fixtures shall be replaceable.
- T. LED system shall comply with all relevant patents.
- U. LED system shall have a selectable means of external control via a data network.
- V. Lighting Manufacturer shall provide system wiring diagrams and installation guides.
- W. The LED module and all of its components must not be subject to mechanical stress. Assembly must not damage or destroy the conducting paths on the circuit board.
- X. Manufacturer shall provide electrical characteristic, light output, luminous intensity distribution and color characteristic and relevant luminance and illuminance photometric data based on test results from an independent testing lab with LM 79-08.
- Y. Manufacturer shall provide photometric data in IES file format in accordance with IES LM-63-2002, based on test results from an independent testing lab.

- Z. For DMX controlled LEDs, manufacturer shall provide the option of a factory-trained applications engineer for on site supervision of start up and/or programming.
- AA. All LED fixtures (100% of each lot) shall undergo a recommended two-week burn-in test after installation and before completion of ceiling finish to test for any LED failures.
- BB. For tunable white LED fixtures, manufacturers to provide appropriate wiring for separate color and intensity control.

## 2.9 SUBMERSIBLE LIGHTING FIXTURES

- A. LED Drivers are integral to the fixture. If External Driver, provide NEMA rated enclosure as required.
- B. Light fixture and mounting clips are comprised of corrosion resistant materials.
- C. Fixture incorporates water stop technology cable separator to prevent water entry by wicking through cable strands. Normal cable glands and resin potting have proven insufficient and without additional means of protection will not be accepted.
- D. Lamp shall contain sufficient gaskets, seals and silicone to protect electronic components from water
- E. LED lamp and all associated electronic components within the fixture shall have a minimum life span of 50,000 hours at nominal ratings.
- F. Manufacturer shall be able to supply results from production leak tests and functional testing, by serial number for each fixture.
- G. Each diode shall be tested for correct light output, voltage and current prior to fixture assembly. Test results shall be recorded by serial number.
- H. Fixture power input shall be polarity agnostic, wiring positive and negative incorrectly is not desirable but will not affect fixture performance.
- I. DMX data lines must be protected and isolated to a minimum of 60 Volts DC.
- J. Fixture shall operate correctly anywhere in the range of supplied power of 11.5 Volts DC to 26 Volts DC.
- K. Lens shall be constructed out of polycarbonate UV and abrasion resistant, impact resistant and yellowing resistant material and shall be optically clear allowing for a maximum of 4% light loss.
- L. IP68 rated up to one meter in depth.
- M. Light shall be UL rated wet/dry up to 86° Fahrenheit.

- N. Light shall be serialized and traceable to all production tests. Tested using pressure decay at 15 PSI (1.1 bar) and certified by manufacturer. Pressure decay system is be capable of detecting 0.1 Pascal (0.000145 psi).
- O. Light comes with submersible cable with wet rated quick disconnect.

### **PART 3 - PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Do not scale electrical drawings for exact location of the lighting fixtures. In general, the architectural reflected ceiling plans indicate the proper locations of lighting fixtures.
- B. Install each fixture properly and safely. Furnish and erect hangers, rods, mounting brackets, supports, frames, and other equipment required.
- C. Furnish lighting fixtures complete with appurtenances required for the proper, safe and distortion-free installation in the various surfaces in which they appear. Determine surface types from the Architectural drawings.
- D. Each lighting fixture shall be packaged with complete instructions and illustrations showing how to install. Install lighting fixtures in strict conformance with manufacturer's recommendations and instructions.
- E. Rigidly align continuous rows of lighting fixtures for true in-line appearance.
- F. Install pendant lighting fixtures plumb and at a height from the floor as specified on the drawings. In cases where conditions make this impractical, refer to the Architect for a decision. Use ball aligners and canopies on pendant fixtures unless noted otherwise.
- G. Do not install fixtures and/or parts such as finishing plates, lenses and trims for recessed fixtures until all plastering and painting that may mar fixtures finish as been completed.
- H. Lighting fixture locations in mechanical and electrical equipment rooms are approximate. Coordinate mounting height and location of lighting fixtures to clear mechanical, electrical and plumbing equipment and to illuminate adequately meters, gauges and equipment.
- I. Support all lighting fixtures independently of duct work or piping.
- J. Whenever a fixture or its hanger canopy is applied to a surface mounted outlet box, a finishing ring shall be utilized to conceal the outlet box.
- K. Splices in internal wiring shall be made with approved insulated "wire nut" type mechanical connectors, suitable for the temperature and voltage conditions to which they are subjected.
- L. All wire utilized for connections to or between individual lamp sockets and lamp auxiliaries (i.e., wires which do not constitute "through circuit" wiring) shall be suitable for temperature, current, and voltage conditions to which it is subjected.

- M. Install reflector cones, baffles, aperture plates, light controlling element for air handling fixtures, and decorative elements after completion of ceiling tiles, painting and general cleanup.
- N. Replace blemished, damaged or unsatisfactory fixtures as directed.

### 3.2 AIMING AND ADJUSTMENT

- A. All adjustable lighting units shall be aimed, focused, locked, etc., by the Contractor under the supervision of the Lighting Consultant. The Lighting Consultant shall indicate the number of crews (foreman and apprentice) required. All aiming and adjusting shall be carried out after the entire installation is complete. All ladders, scaffolds, etc. required shall be furnished by the Contractor. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely.
- B. When possible, units shall be focused during the normal working day. However, where daylight interferes with seeing, aiming shall be accomplished at night.

### 3.3 CLEANUP

- A. At the time of final acceptance by the Owner, all lighting fixtures and lamps shall have been thoroughly cleaned with materials and methods recommended by the manufacturers, all broken parts shall have been replaced, and all lamps shall be operative.

TYPE	DESCRIPTION	WATTAGE	CONTROL TYPE	Issue Dates				DELETED
				9/27/2019				
R01	Submersible LED uplight in center of fountain basin	5W	NON DIM	✓				
R02	Recessed adjustable LED Narrow beam uplight at Flag Poles	30W	NON DIM	✓				
R03	Recessed LED asymmetric step light at south ramp	4W	NON DIM	✓				
R04	Surface mounted linear LED adjustable 9x29 degree grazing uplight fixture at memorial wall	12 W/LF	ELV-010V	✓				
R04-A	Surface mounted linear LED adjustable 40x40 degree grazing uplight fixture at memorial wall	12 W/LF	ELV-010V	✓				
R05	Surface mounted LED narrow-beam submersible fixture at Flume channel niche	3 W/LF	NON DIM	✓				
R06	Surface mounted linear adjustable LED downlight at Dedication Plaque	6 W/LF	NON DIM	✓				
R07	Submersible LED adjustable fixtures in water cavity below Rookie fountain.	6 W/LF	NON DIM	✓				
R08	Submersible LED uplights at water feature at Rookie fountain.	5W	NON DIM	✓				
R09	Recessed LED asymmetric uplights at North entry wall	10W	NON DIM	✓				
R10	Handrail integrated low glare LED asymmetric downlights	2 W	NON DIM	✓				
R11	Recessed submersible LED grazing fixture in reflection pond fountain base	5W	NON DIM	✓				
R12	Recessed adjustable LED Flood beam uplight at Flag Poles	30W	NON DIM	✓				

## Function

The LED008001 Slab Hanger Compact White LED Light comes in a compact package. It is designed for situations where visibility of the light fixture needs to be de-emphasized and space near the nozzle is tight (Narrow troughs). Provides gentle lighting of lower effects.

## Specifications

Construction of fixture shall be plastic and 304/316 stainless steel.  
Hardware included:

- LED emitter: 5 W / 350mA.
- Input Voltage: 12 VDC to 24VDC
- 9 ft [2.75m] or 20FT[6m] of type ST or SO submersible cable. Select when ordering.
- Clear lexan lens
- UV stabilized Delrin Top Face
- Optic: Polycarbonate 20°

### 1. Order your LED:

Part No.	Lamp	Color Temperature	Mounting	Application
LED008001	White	5600K (Cool)	Slab Hanger	Wet/Dry
LED008024	White	2600K (Warm)	Slab Hanger	Wet/Dry

\* For specific color temperature contact CF

### 2. Add one of the cables:

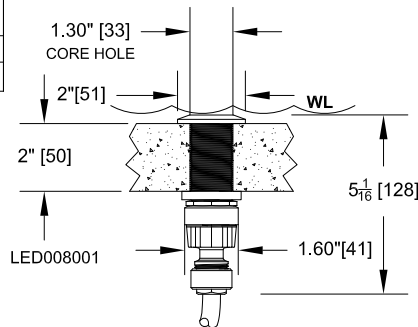
Cable	Part No.
9ft. 16/3 STW	ELCORD007LW09
20ft. 16/3 STW	ELCORD007LW20
European cable	
3m 5x1mm HO5RN-F	ELCORD007MW03
6m 5x1mm HO5RN-F	ELCORD007MW06

## Options:

- EL PKIT10 - DMX/RDM Addressing and Play Show Tool

## Notes

- The light is IP68 rated.
- Fixture must be installed by a qualified electrician in accordance with all state and local codes.
- Connect submersible cable to submersible junction boxes.
- For wiring refer to page 2 and instruction shipped with product.
- Contact Crystal Fountains for detailed specification, installation and operation.



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www.crystalfountains.com  
**Crystal**  
where ideas flow™  
TEL, 1-905,660,6674 FAX, 1-905,660,6916

**12VDC TO 24VDC 5W MAX. Non-Dimmable  
WHITE SLAB HANGER COMPACT LED  
LIGHT**

SERIES  
LED008

REV.  
K  
SEP 2017

Due to technical progress, all designs, specifications, data sheets and components are subject to change without notice. All product information contained in this cut sheet is for information only. Please consult our web site for up to date engineering drawings. Certificates of conformance issued if required.

## Notes:

Submersible LED  
uplight in center of  
fountain basin

MOD Face Shield  
cover

Fixture to be  
NON DIM

Provide remote  
power supply(s) as  
required. Power  
supply(s) to be  
located in a well  
ventilated, accessible  
area.

Remote driver(s) to  
be rated for exterior  
use. Additional wet  
location enclosure  
box and/or direct  
burial enclosure may  
be required.

Requires  
manufacturer  
provided shop  
drawing(s) for  
approval during shop  
drawing coordination

Notes continue on  
next page....

- ☐ Standard  
☒ Modified Standard  
☐ Custom  
☐ Sample Required

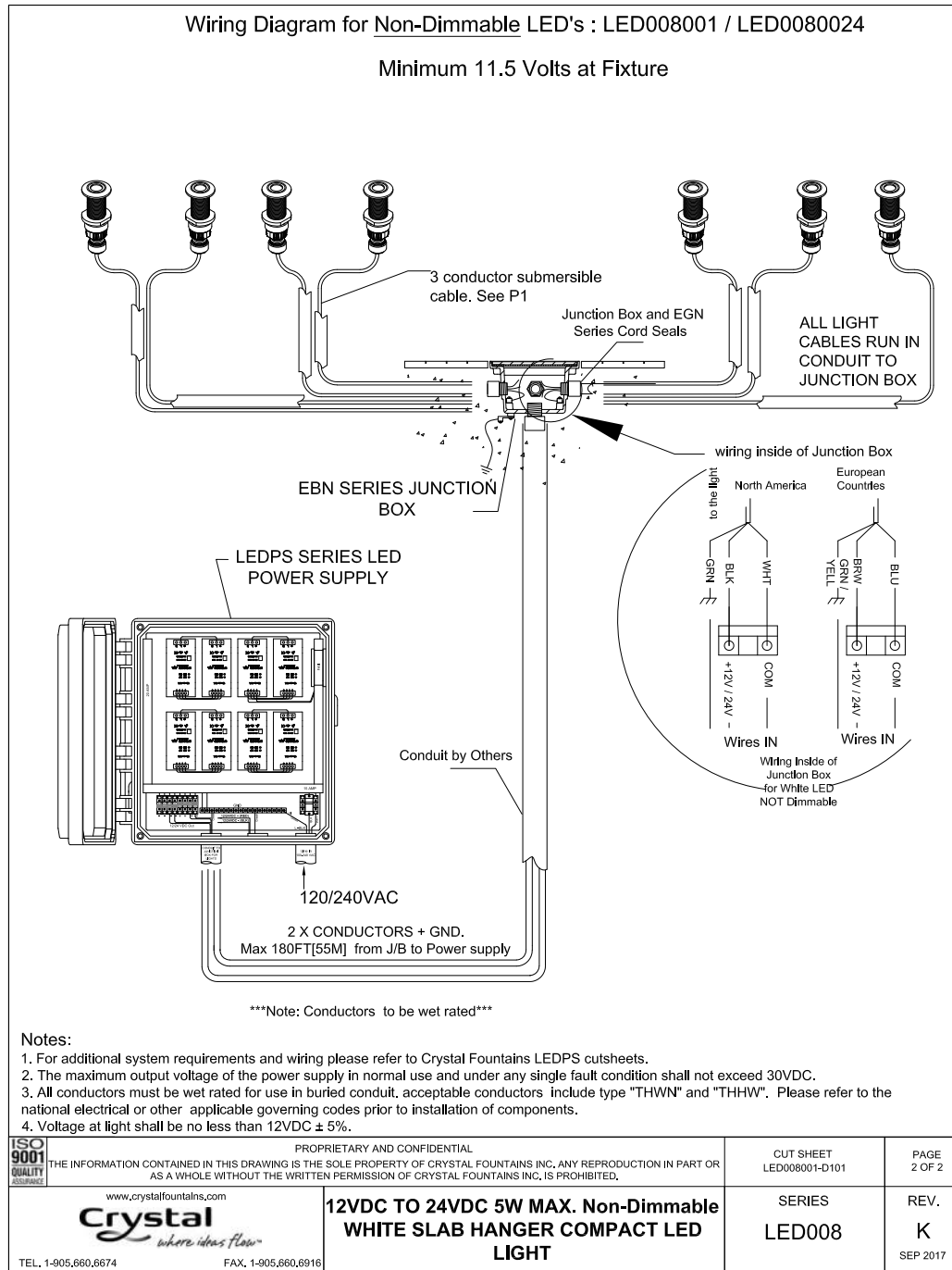
**Manufacturer:** CRYSTAL FOUNTAINS  
**Catalog Number:** LED008024 + LEDPS603-12VDC-960W + ELCORD007LW20 (AS REQ'D) + EBN208A101 (SUBMERSIBLE JBOX AS REQ'D) + EGN075 + PF1316 + EBJ C10  
**Lamp:** 2600K LED (Included)  
**Wattage :** 5W  
**Voltage:** 120V  
**Finish:** Manufacturer Standard Stainless Steel

**Type:**

**R01**

Page 1 of 7

☐ Part of Series



**Notes:**

Refer to manufacturer's recommendations for maximum remote distance to minimize voltage drop

Coordinate leader cables, joiners, terminators and any additional parts as required for a complete installation

Provide enough slack in power cable to allow fixture to be removed with access stone as required.

Provide 20% of each type and rating installed for Attic Stock. Furnish at least one of each type.

Type:

**R01**

Page 2 of 7



Notes:

**Function**

Crystal Fountains LEDPS603 and LEDPS604; White Non Sequencing LED Lighting - Power Supplies are an integral component in an overall LED lighting system including (LED light + Power Supply ). The LEDPS603 (12VDC) and LEDPS604 (24VDC) power supplies are used with Crystal's non Sequencing LED Lighting .They provide 960 watts of power and can work with the following Crystal LED products:

LED008 Light Series	LED170 Light Series	LED260 Light Series
LED040 Light Series	LED180 Light Series	LED150 Dynamite Blast
LED160 Light Series	LED190 Light Series	LED165 Light Series
LED002 Light Series		

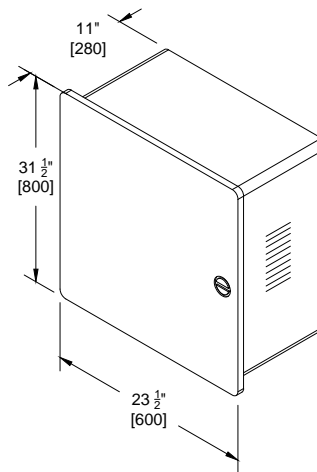
The design of the LEDPS series provides simplified wiring, ensuring system efficiency.

**Specification**

Enclosure - fiberglass or plastic box , NEMA 4  
Input voltages of 115VAC or 230VAC.  
UL508A compliance.  
Power - 960 Watts  
Operating temperature: -10°C to +40°C

**Notes**

1. Outdoor rated.
2. In coming line voltage for LEDPS is 115/230VAC, 10/5 Amp, 50-60Hz.
3. Refer to table for voltage output to LEDs.
4. refer to page 3. for internal wiring and termination diagram
5. The design of all low voltage lighting systems must include a review of voltage drop in relation to the distance of the conductor runs and the size of the conductors being run. For information on specific requirements refer to the cut sheets and installation guides of the specific product being controlled with the LEDPS series power supply
6. Contact Crystal Fountains for detailed specification, installation and operation details.
7. Fixture must be installed by a qualified electrician, in accordance with local and national codes.
8. Not all lighting solutions can be solved using the LEDPS. Please contact Crystal Fountains for custom power supply solutions.



Part No.	Output Voltage	No. of LED's powered	WHITE LED Series (30w)	No. of LED powered	WHITE LED Series (60w)	No. of LED powered	LED Series ( 5W )
LEDPS603	12VDC 80A	24	LED 160,165,170, 180, 190	12	LED260	150	LED008 LED002
LEDPS604	24VDC 40A	24	LED 165	12	LED260		

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 <small>www.crystalfountains.com</small> <small>TEL. 1-905.660.6674 FAX. 1-905.660.6916</small>		<b>12 &amp; 24VDC POWER SUPPLY LEDPS603 AND LEDPS604</b>		<b>SERIES LEDPS</b>	<b>REV. C MAR 2017</b>	

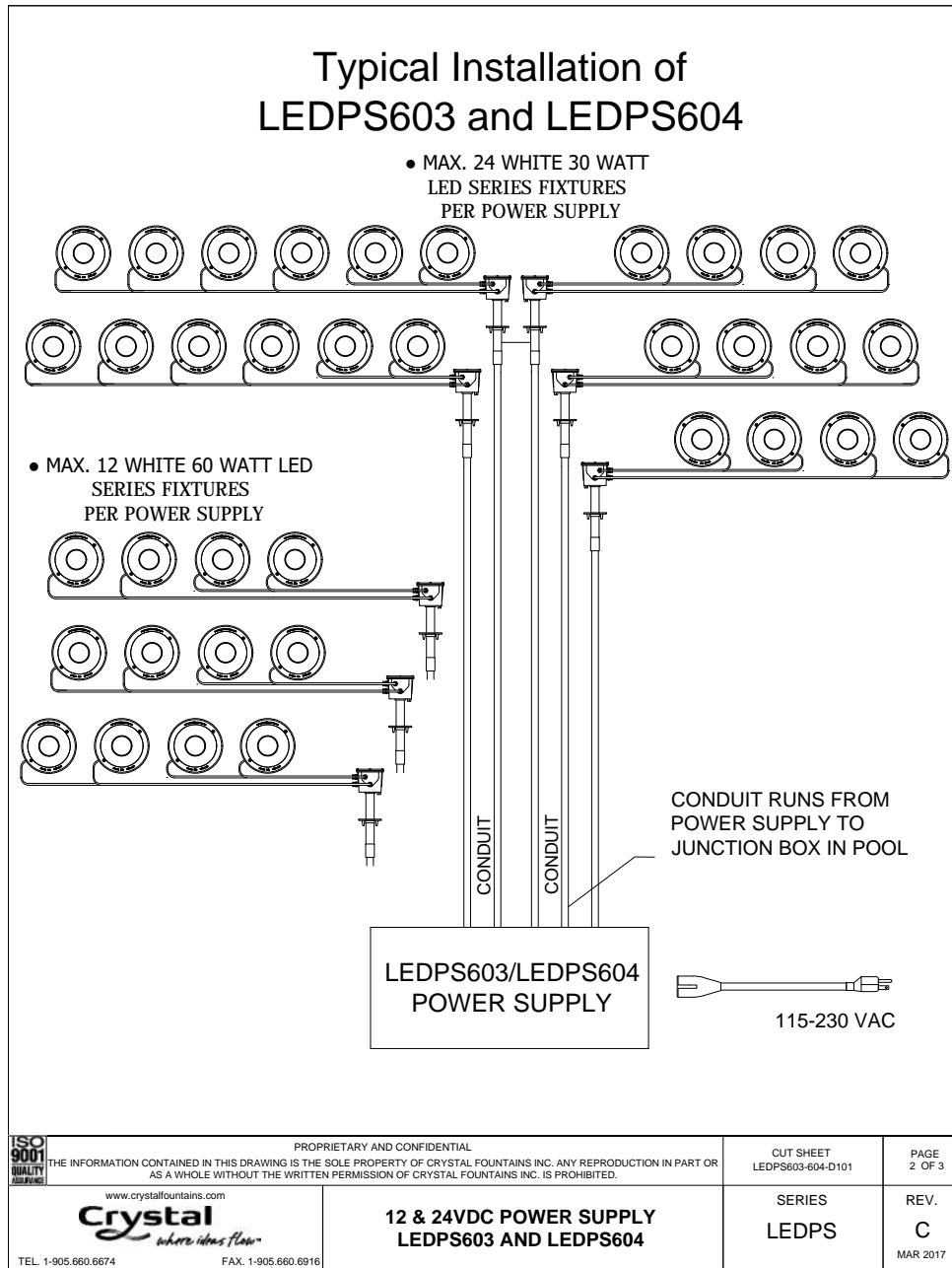
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Type:

**R01**

Page 3 of 7

Notes:

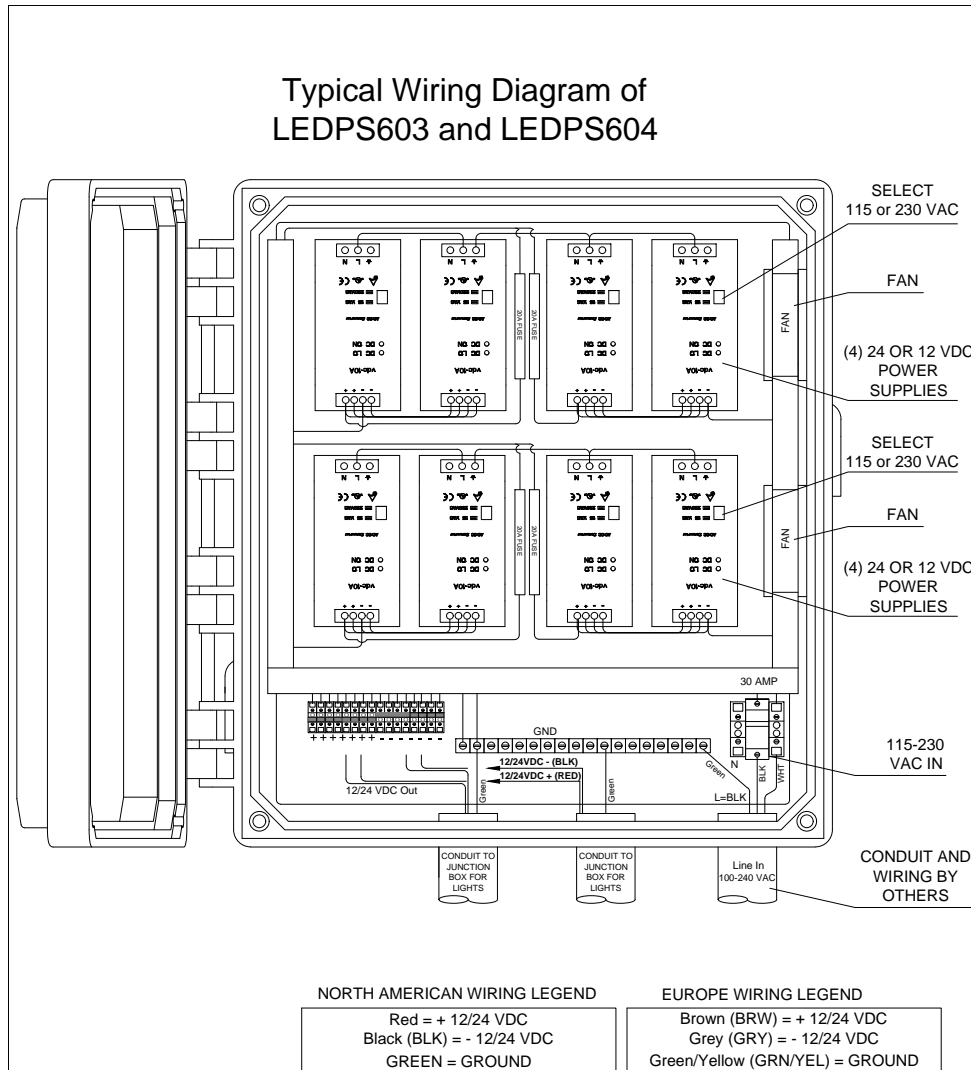


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R01

Page 4 of 7

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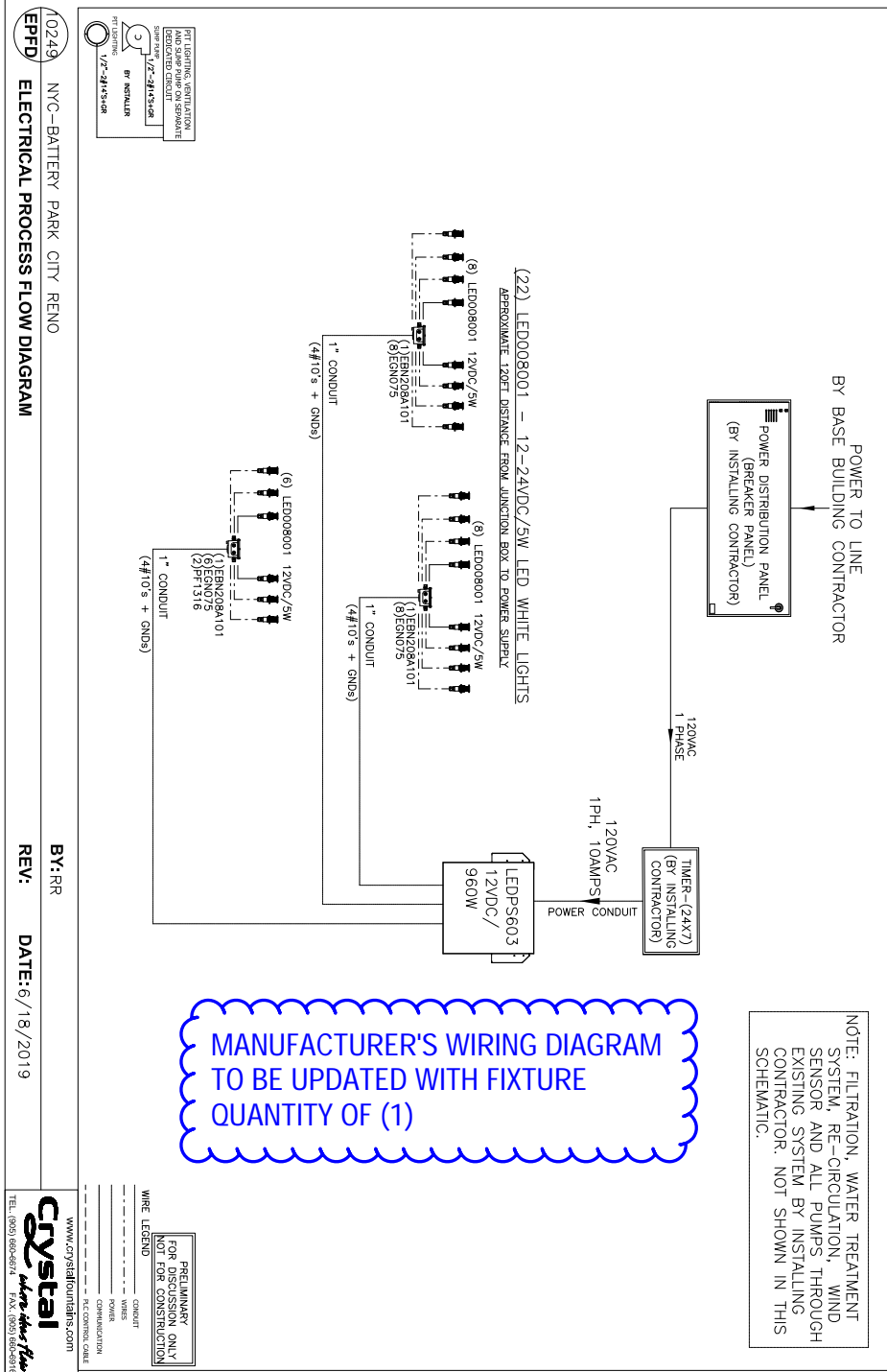
	<small>PROPRIETARY AND CONFIDENTIAL</small> <small>THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CRYSTAL FOUNTAINS INC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CRYSTAL FOUNTAINS INC. IS PROHIBITED.</small>	<small>CUT SHEET</small> <small>LEDPS603-604-D101</small>	<small>PAGE</small> <small>3 OF 3</small>
 <small>www.crystalfountains.com</small> <small>TEL. 1-905.660.6674 FAX. 1-905.660.6916</small>	<b>12 &amp; 24VDC POWER SUPPLY LEDPS603 AND LEDPS604</b>	<small>SERIES</small> <b>LEDPS</b>	<small>REV.</small> <b>C</b> <small>MAR 2017</small>

Due to technical progress, all designs, specifications, data sheets and components are subject to change without notice. All product information contained in this cut sheet is for information only. Please consult our web site for up to date engineering drawings. Certificates of conformance issued if required.

Type:

**R01**

Page 5 of 7



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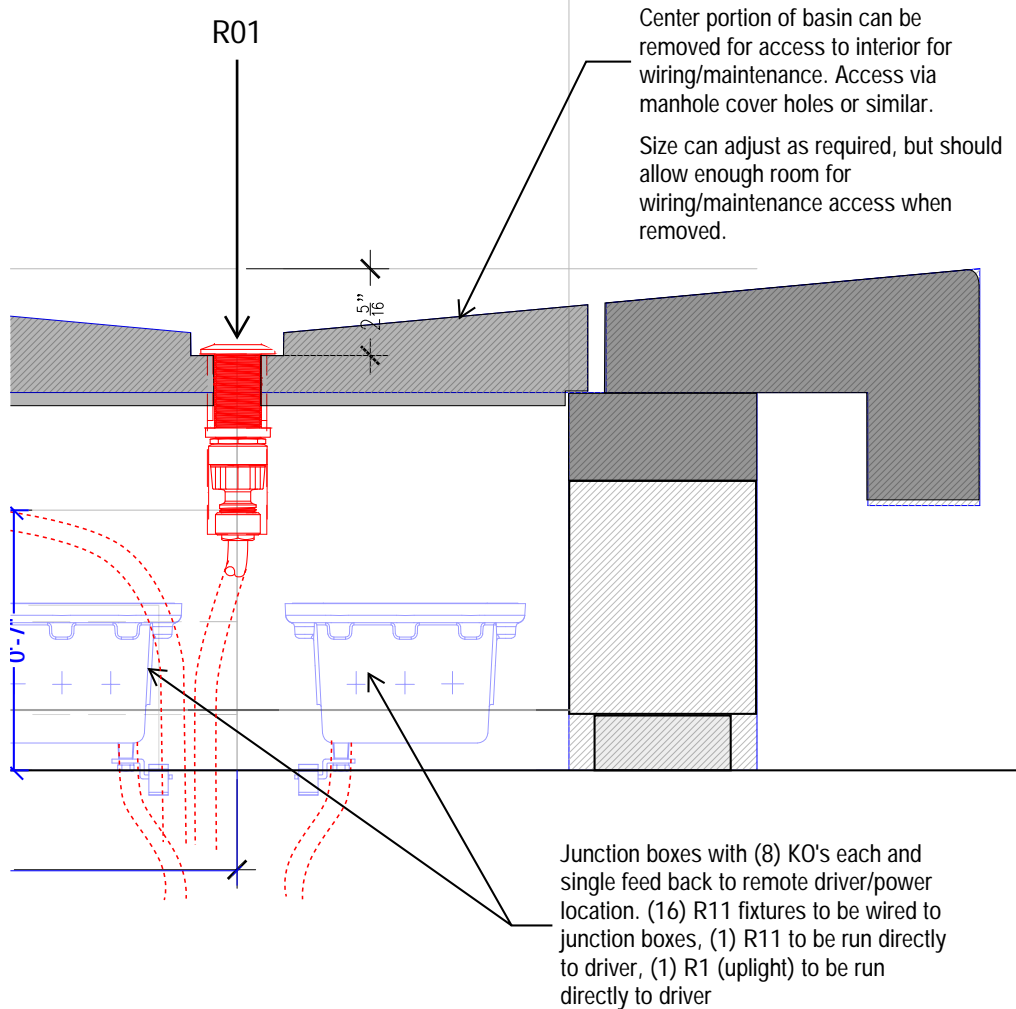
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**R01**

Page 6 of 7

Notes:

**\*FOR DESIGN INTENT ONLY\***



Type:

**R01**

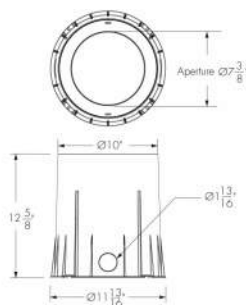
Page 7 of 7

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

Project Name \_\_\_\_\_ Qty \_\_\_\_\_

Type \_\_\_\_\_ Catalog / Part Number \_\_\_\_\_



Top view

Front view

Shown with FLN trim type

### Photometric Summary

Symmetric	Delivered output (lm)	Intensity (peak cd)	Power <sup>[1]</sup> (120V) [W]
VN (6°)	1695	83,330	30 <sup>[4]</sup>
NS (10°)	4371 <sup>[3]</sup>	63,536	60 <sup>[2]</sup>
M (30°)	4929 <sup>[3]</sup>	21,162	60 <sup>[2]</sup>
FL (40°)	4442 <sup>[3]</sup>	10,611	60 <sup>[2]</sup>
WFL (60°)	4118 <sup>[3]</sup>	4157	60 <sup>[2]</sup>

Bi-symmetric	Delivered output (lm)	Intensity (peak cd)	Power <sup>[1]</sup> (120V) [W]
6°x90°	1585	8136	30 <sup>[4]</sup>
90°x6°			
15°x90°	3670 <sup>[3]</sup>	9152	60 <sup>[2]</sup>
90°x15°			
25°x90°	3836 <sup>[3]</sup>	5471	60 <sup>[2]</sup>
90°x25°			
35°x90°	3396 <sup>[3]</sup>	3536	60 <sup>[2]</sup>
90°x35°			

Asymmetric	Delivered output (lm)	Intensity (peak cd)	Power <sup>[1]</sup> (120V) [W]
NAS	1713	26,491	30 <sup>[4]</sup>
WW	2182	3250	36 <sup>[2]</sup>

Based on 4000K, On/Off configuration. Tested with IFR lens for VN optic, SFR lens for NAS, WW optics and CL lens for all other optics.

Photometric performance is measured in compliance with IESNA LM 79-08. Consult photometric files for static color information.

- [1] Add 5 W per fixture when specifying DMX/RDM.  
[2] Use 39 W when specifying luminaire for white light.  
[3] 70% output for luminaire, 80% output for DALI when specifying white light.  
[4] Use 32 W when specifying luminaire for VN, 6°x90°, 90°x6° and NAS.

### Description

The lumenbeam Inground Large is a high-performance, ground-recessed LED projector designed to solve a range of inground lighting challenges with a choice of optics, trim, lenses and control options. The plug and play design simplifies installation, protecting the system from water infiltration and ensuring long-lasting performance. Built with robust, high-quality materials, with an option of resistance to harsh environments, the lumenbeam Inground Large delivers L70 LED lifetimes from 79,000 up to 370,000 hours, has a Drive-Over rating of 5000kg, IK10 glass lens and an IP68 factory-sealed optical chamber.

### Features

<b>Construction</b>	Walk over compliant up to 1000 kg in any type of ground, Drive over compliant up to 5000 kg in concrete
<b>Color and Color Temperature</b>	2200K, 2700K, 3000K, 3500K, 4000K, 5700K, Red, Green, Blue
<b>Optics (nominal distribution)</b>	VN (6°), NS (10°), M (30°), FL (40°), WFL (60°), 6° x 90°, 15° x 90°, 25° x 90°, 35° x 90°, 90° x 6°, 90° x 15°, 90° x 25°, 90° x 35°, NAS (Narrow Asymmetric), WW (Asymmetric Wallwash)
<b>Lens</b>	Clear lens, Small frosted ring, Large frosted ring, Softening lens, (lens type will vary according to optic, see optics and lens section)
<b>Optical Option (factory installed)</b>	Internal louver
<b>Trim Type</b>	Flush trim with hardware, Flush trim no hardware, Bevel edge trim with hardware, Bevel edge trim no hardware
<b>Blockout</b>	Recessed blockout, Recessed blockout with mounting brackets
<b>Options</b>	Anti-slip lens, Brass material suitable for harsh environments
<b>Adjustment</b>	-3° to +15° tilt, 360° rotation
<b>Power Consumption</b>	30 W to 60 W
<b>Warranty</b>	5-year limited warranty

**lumenpulse™**

1220 Marie-Victorin Blvd., Longueuil, QC J4G 2H9 CA T United States 617.307.5700 | Canada 1.877.937.3003 | 514.937.3003 F 514.937.6289  
info@lumenpulse.com www.lumenpulse.com www.lumenpulse.com/products/1740/lumenbeam-inground-large

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SA - 84

1 / 14

### Notes:

Recessed adjustable  
LED Narrow beam  
uplight at Flag Poles

Site conditions to be  
evaluated before  
fixture order - confirm  
existing conduit feed  
placement for  
alignment for side  
feed for fixtures.

Fixture to be  
NON DIM

Possible MOD for  
bottom power feed if  
required for existing  
site conditions (to be  
confirmed with site  
conditions)

Fixture has Integral  
Driver

Notes continue on  
next page...

Alternates:  
LUMASCAPE:

LS363LED-16H6-G-I-  
82-NR-21-Q-09

- ☒ Standard  
☐ Modified Standard  
☐ Custom  
☐ Sample Required

Manufacturer: LUMENPULSE  
Catalog Number: LBIL-DO-120/277-30K-VN-CL-INTL-NO-FLH-SSB-RBM-ASL-HRS-UL

Lamp: 3000K LED (Included)  
Wattage : 30W  
Voltage: 120V  
Finish: Brushed Stainless Steel, Architect to Confirm

Type:

**R02**

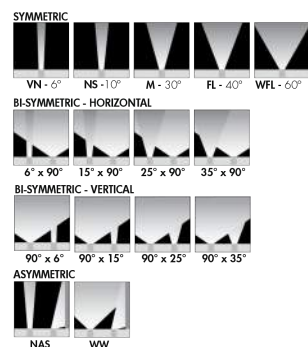
Page 1 of 14

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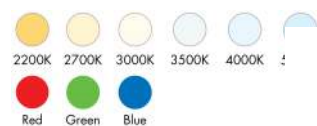
## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

### Optics



### Colors and Color Temperatures



### Controls



### Construction



### Trim Finishes



### Options



### Ratings



### Performance

Maximum Delivered Output	4929 lm (4000K, M 30°, CL lens, On/Off control)
Maximum Delivered Intensity	83,330 cd at nadir (4000K, VN 6°, LFR lens, On/Off control)
Illuminance at Distance	Minimum 1 fc at 288 ft (4000K, VN 6°, LFR lens, On/Off control)
Color Consistency	2 SDCM, 3 SDCM (2200K and 5700K)
Color Rendering	Minimum CRI 80
Lumen Maintenance	L70 79,000 to 370,000 hrs (Ta 25 °C), L70 77,000 to 90,500 hrs (Ta 40 °C)

### Physical

Optical Chamber Material	Aluminum for walk-over and drive-over construction, Brass for walk-over and drive-over construction in harsh environments
Blockout Material	Fiberglass reinforced polymer
Lens Material	Tempered glass
Hardware Material	Stainless steel

ISSUED FOR PERMITTING AND BIDDING  
October 16, 2019

### Electrical and Control

Voltage	120-277 volts, 220-240 volts
Leader Cable Conductor	6C #14-3/ #24-3
Leader Cable Connector	IP68 6-pin push-lock
Control	On/Off control, Lumentalk, 0-10V dimming, DALI dimming, DMX/RDM enabled
Resolution (DMX/RDM)	Per fixture, 8-bit or 16-bit

### Environmental

Storage Temperature	-40 °F to 185 °F (device must reach start-up temperature value before operating)
Start-up Temperature	-13 °F to 104 °F
Operating Temperature	-40 °F to 104 °F, Consult factory for -40 °F to 122 °F temperature range
Ingress Protection Rating	IP68 (submerged up to 3.3 ft for up to 24 hours), not suitable for permanent immersion applications
Impact Resistance Rating	IK10
Environment	Wet location

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2 / 14

### Notes:

Architect to confirm  
asphalt pavers  
thickness to confirm  
Trim

Requires  
manufacturer  
provided shop  
drawing(s) for  
approval during shop  
drawing coordination

Coordinate leader  
cables, joiners,  
terminators and any  
additional parts as  
required for a  
complete installation

Architect to confirm  
finish

Manufacturer to  
confirm  
recommended  
parts/fixtures as attic  
stock. Furnish at least  
one fixture.

### Type:

**R02**

Page 2 of 14

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

## Notes:

### Certifications



### Accessories (order separately)

<b>Cables</b>	3 Conductor Power and 3 Conductor Data Leader Cable with Connector, 3 Conductor Power and 3 Conductor Data Cable
<b>Electrical Accessories</b>	Large Junction Box for Lumenbeam Inground
<b>Control Boxes</b>	DMX/RDM enabled (daisy chain or star configuration), Ethernet enabled (daisy chain or star configuration)
<b>Control Systems</b>	Lumentone™ 2, Pharos® kit
<b>Diagnostic and Addressing Tools</b>	LumenID, LumentalkID

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3 / 14

## Type:

**R02**

Page 3 of 14





Notes:

Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

Construction details

	WO - Walk over compliant up to 1000kg	DO - Drive over compliant up to 5000kg		Standard construction	HRS - Brass material suitable for harsh environments
Trim type	All trim options are suitable (FLH, FLN, BVH and BVN)	Only trim options with visible hardware are suitable (FLH and BVH)	Optical chamber housing material	 Aluminum	 Brass
Ground type	Installed in sand, soft soil, compacted soil, pavement or concrete	Installed in concrete	Installation environment	Locations without de-icing salt or non-coastal zones	All locations

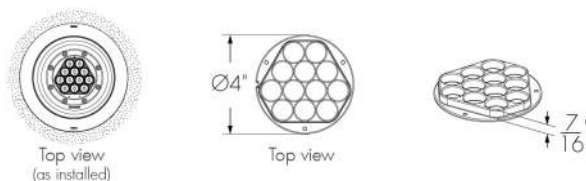
Optics and lens options

Optics / Lens	Clear	Small frosted ring	Large frosted ring	Softening	Anti-slip
VN			<input checked="" type="checkbox"/>		
NS/M/FL/WFL	<input checked="" type="checkbox"/>				
6° / 15° / 25° / 35° x 90°	<input checked="" type="checkbox"/>				
NAS/WW		<input checked="" type="checkbox"/>			

☒ Recommended for optimal performance, may be replaced by a softening lens. A softening lens will affect beam distribution and output. Consult factory for application support.

Optical accessories (factory installed)

INTL - Internal louver



- The internal louver is factory installed and not adjustable in the field.
- Not available for NAS, WW optics.
- The addition of an internal louver will affect beam distribution, consult factory for application support.

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4 / 14

Type:

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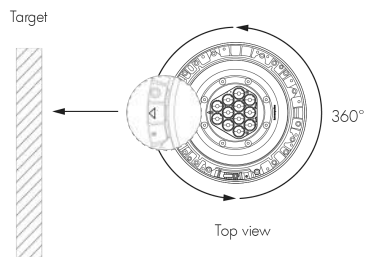
Page 4 of 14

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

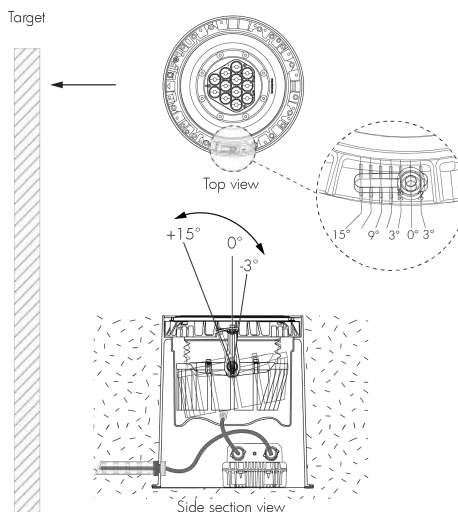
### Adjustment

#### 360° Orientation



The optical chamber can be rotated until the arrow faces the target.  
Refer to the installation instructions for details.

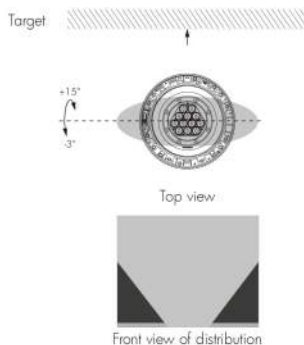
#### -3° to +15° Tilt adjustment



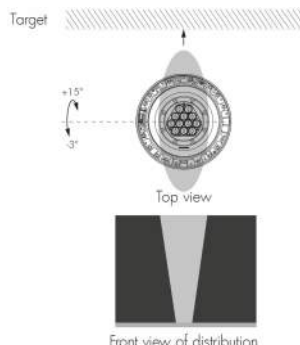
- Tilt can be adjusted on site without opening the factory sealed optical chamber.
- **Asymmetrical optics:** Tilt set in factory for optimal results (WW at 5° and NAS at 3°).

### Bi-symmetrical distributions

Horizontal distribution : 6°x90°, 15°x90°, 25°x90°, 35°x90°



Vertical distribution : 90°x6°, 90°x15°, 90°x25°, 90°x35°



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5 / 14

Notes:

Type:

**R02**

Page 5 of 14

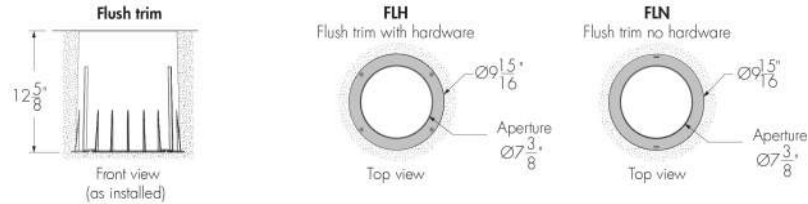
## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

## Notes:

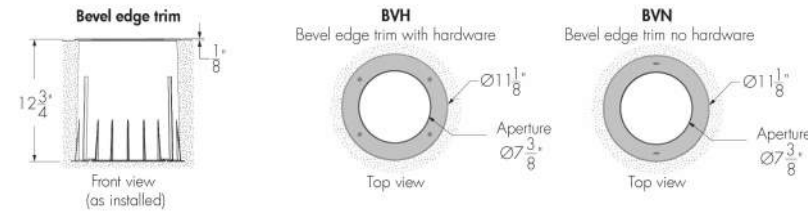
### Trim type

#### Flush trim



Only trims with hardware are drive-over compliant.

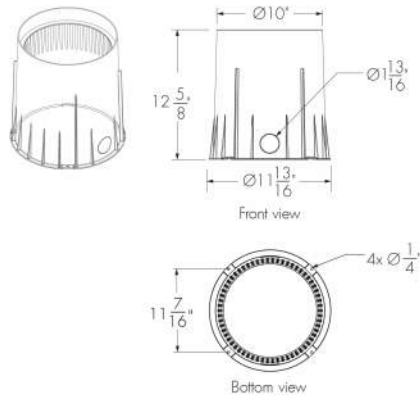
#### Bevel edge trim



### Blockout

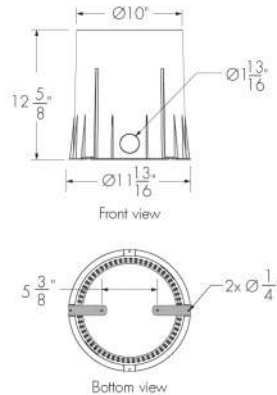
#### RBO - Recessed Blockout

##### RBO - Recessed blockout



#### RBM - Recessed Blockout with Mounting Brackets

##### RBM - Recessed blockout with mounting brackets



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6 / 14

## Type:

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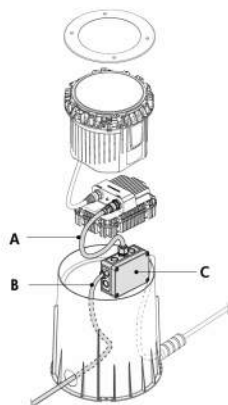
Page 6 of 14

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

## Notes:

### Overview - cables and accessories



**A - 3P3DLC:** 3 Conductor Power and 3 Conductor Data Leader Cable with Connector

**B - 3P3DLC:** 3 Conductor Power and 3 Conductor Data Cable

**C - LBI-JBOX-L:** Large Junction Box for Lumenbeam Inground (required for continuous run)

Refer to typical wiring diagrams for details.

### Cables (order separately)

**3P3DLC - 3 Conductor Power and 3 Conductor Data Leader Cable with Connector**



**CERTIFICATION:** UL or CE  
**LENGTH:** 10 ft, 25 ft or 50 ft

- Sealing endcap is mandatory for all unused connectors. One (1) included with every leader cable.
- Consult 3P3DLC specification sheet for details.

**3P3DLC - 3 Conductor Power and 3 Conductor Data Cable**



**CERTIFICATION:** UL or CE  
**LENGTH:** 50 ft, 100 ft, 150 ft, 200 ft or complete spool of cable 250 ft

### Electrical accessories (order separately)

**LBI-JBOX-L - Large Junction Box for Lumenbeam Inground (required for continuous run)**



#### Included

- 1x Junction box with 16 in 3P3DLC cable whip
- 4x Strain reliefs
- 1x IP68 insulating resin
- 1x Sealing cap

Refer to LBI-JBOX-L installation instructions for details.

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7 / 14

Type:

**R02**

Page 7 of 14

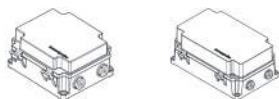
## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

## Notes:

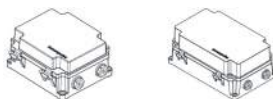
### Control boxes (order separately)

#### CBX-DMX/RDM - DMX/RDM enabled (daisy chain or star configuration)



DMX/RDM control box. Up to six power and data outputs to fixtures or fixture runs. Consult CBX specification sheet and installation instructions for details. Lumenterminators provided with CBX (2x for daisy chain configuration, 6x for star configuration), consult factory to order spares.

#### CBX-ENET - Ethernet enabled (daisy chain or star configuration)



Ethernet control box. Up to four power and data outputs to fixture or fixture runs. Consult Ethernet CBX specification sheet and installation instructions for details.

### Control systems (order separately)

#### LTN2 - Lumentone™ 2



Lumentone 2 is a simple pre-programmed DMX 512 controller with a push button rotary dial and live feedback.

#### PHAROS - Pharos® kit



The Pharos kit, available for 1 or 2 DMX universes, allows for complete control of large lighting installations. 2 DMX universes kit shown.

### Diagnostic and addressing tools (order separately)

#### LID - LumenID



LumenID is a diagnostic and addressing DMX/RDM tool. It must be specified on all DMX applications. Consult LID specification sheet for details.

#### LID-LT - LumentalkID



LumentalkID is a diagnostic and addressing tool. It must be specified for all Lumentalk (LT) applications. Consult LID-LT specification sheet for details.

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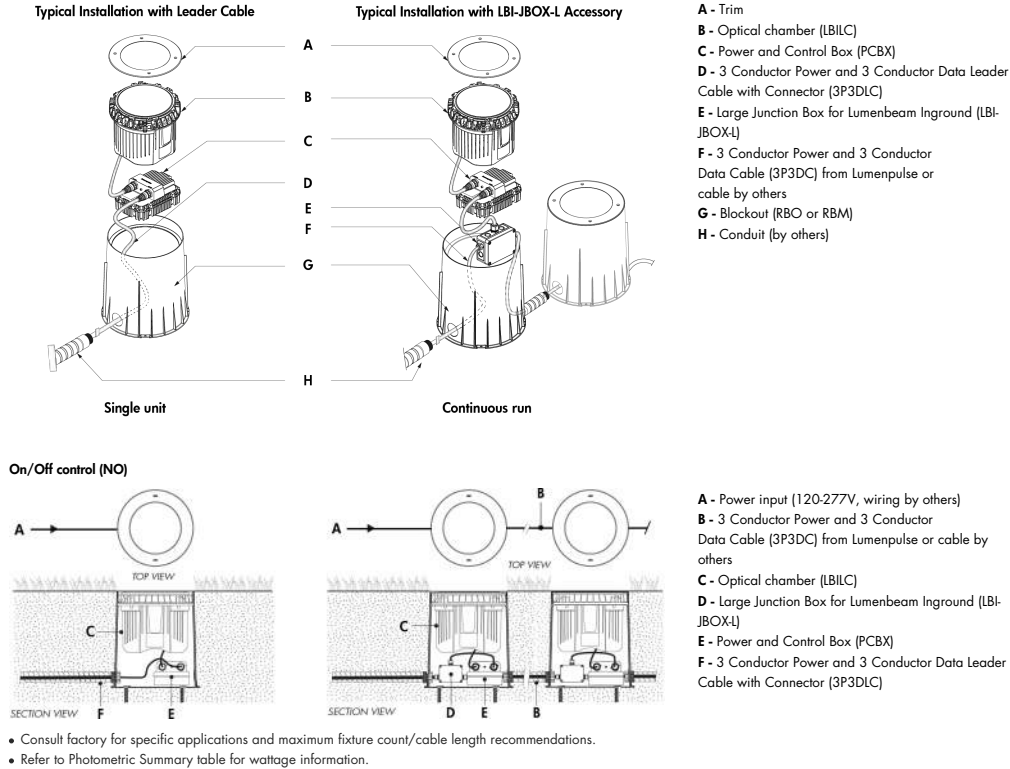
Page 8 of 14

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

## Notes:

### Typical wiring diagrams



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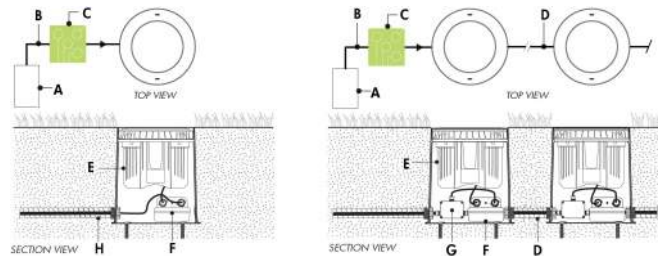
Page 9 of 14

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

## Notes:

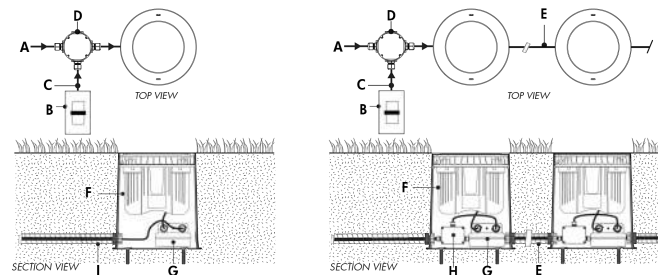
### Lumentalk (LT)



- A - Dimmer/controller (order separately from Lumenpulse, or by others)
- B - Data wiring (by others)
- C - Lumentranslator 2 (LT2 -010, -DMX, -TRIAC, -DALI)
- D - 3 Conductor Power and 3 Conductor Data Cable (3P3DC) from Lumenpulse or cable by others
- E - Optical chamber (LBILC)
- F - Power and Control Box (PCBX)
- G - Large Junction Box for Lumenbeam Inground (LBI-JBOX-L)
- H - 3 Conductor Power and 3 Conductor Data Leader Cable with Connector (3P3DLC)

- Consult factory for specific applications and maximum fixture count/cable length recommendations.
- Lumentalk enabled fixtures must be commissioned using LumentalkID software and a LID-LT. Consult factory for details.
- Maximum of 1 transmitter (Lumentranslator or Lumenlink) per system. No third party fixtures allowed on the same circuit.
- For DMX applications: 1 DMX controller per Lumentalk network, maximum of 48 DMX channels per Lumentalk network (minimum step transition update rate is 1 second, minimum fade time between two colors is 1 minute). Consult factory for applications that require additional capabilities.
- Consult factory for DALI Lumentalk applications.
- 1% minimum dimming value. Refer to Photometric Summary table for wattage information.

### 0-10V dimming (DIM)



- A - Power input (120-277V, wiring by others)
- B - Dimmer (by others)
- C - Data wiring (by others)
- D - Junction box (by others)
- E - 3 Conductor Power and 3 Conductor Data Cable (3P3DC) from Lumenpulse or cable by others
- F - Optical chamber (LBILC)
- G - Power and Control Box (PCBX)
- H - Large Junction Box for Lumenbeam Inground (LBI-JBOX-L)
- I - 3 Conductor Power and 3 Conductor Data Leader Cable with Connector (3P3DLC)

- Consult factory for specific applications and maximum fixture count/cable length recommendations.
- 0-10V mA ratings: passive dimmer (Current Sink): 3mA per fixture, active dimmer (Current Source): 0.5mA per fixture.
- 10% minimum dimming value. Refer to Photometric Summary table for wattage information.

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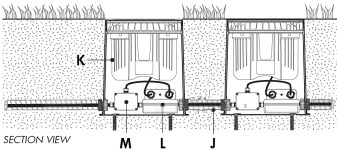
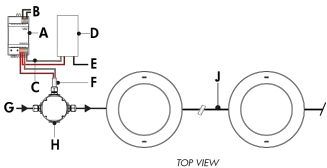
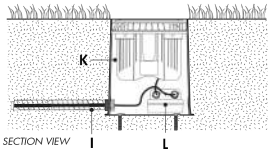
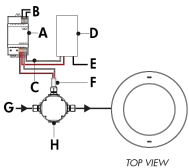
Page 10 of 14

Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

Notes:

DALI dimming (DALI)



- A - DALI bus power supply (by others)
- B - Power input for DALI bus power supply (wiring by others)
- C - To DALI controller (by others)
- D - DALI controller (by others)
- E - Power input for DALI controller (wiring by others)
- F - To fixture
- G - Power input (120-277V, wiring by others)
- H - Junction box (by others)
- I - 3 Conductor Power and 3 Conductor Data Leader Cable with Connector (3P3DLC)
- J - 3 Conductor Power and 3 Conductor Data Cable (3P3DC) from Lumenpulse or cable by others
- K - Optical chamber (LBILC)
- L - Power and Control Box (PCBX)
- M - Large Junction Box for Lumenbeam Inground (LBIL-JBOX-L)

- Consult factory for specific applications and maximum fixture count/cable length recommendations.
- Maximum of 64 DALI fixtures per DALI loop.
- The Lumenbeam Inground Large responds to RGBWAF controls.
- Commissioning may be required based on the selection of 3rd party DALI controller. Controller and commissioning provided by others.
- Refer to Photometric Summary table for wattage information.

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11 / 14

Type:

**R02**

Page 11 of 14



## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

## Notes:

How to order							
1	2	3	4	5	6	7	8
9	10	11	12	13			

### 1. Housing <sup>(1)</sup>

**LBIL** Lumenbeam Inground Large

<sup>(1)</sup> A Lumenbeam Inground fixture includes one optical chamber (LBILC), one Power and Control Box (PCBX), one recessed blackout with temporary blackout cover (RBO or RBM) and one trim (FLH, FLN, BVH or BVN). The LBILC and PCBX are provided according to the optic and control configuration.

### 2. Construction

**WO** Walk over  
**DO** Drive over <sup>(1)</sup>

<sup>(1)</sup> A trim option with hardware (FLH or BVH) must be specified for DO construction.

### 3. Voltage

**120/277** 120-277 volts <sup>(1)</sup>  
**220/240** 220-240 volts <sup>(2)</sup>

<sup>(1)</sup> Available for UL certification only.

<sup>(2)</sup> Available for CE certification only.

### 4. Color and Color Temperature <sup>(1)</sup>

**22K** 2200K  
**27K** 2700K  
**30K** 3000K  
**35K** 3500K  
**40K** 4000K  
**57K** 5700K  
**RD** Red <sup>(2)</sup>  
**GR** Green <sup>(2)</sup>  
**BL** Blue <sup>(2)</sup>

<sup>(1)</sup> Consult factory for availability of static Royal Blue, Amber, 6500K and 90+ CRI.

<sup>(2)</sup> Static colors made to order 8-10 weeks.

### 5. Optics

**VN** Very Narrow 6°  
**NS** Narrow Spot 10°  
**M** Medium 30°  
**FL** Flood 40°  
**WFL** Wide Flood 60°  
**6x90** 6° vertical x 90° horizontal  
**15x90** 15° vertical x 90° horizontal  
**25x90** 25° vertical x 90° horizontal  
**35x90** 35° vertical x 90° horizontal  
**90x6** 90° vertical x 6° horizontal  
**90x15** 90° vertical x 15° horizontal  
**90x25** 90° vertical x 25° horizontal  
**90x35** 90° vertical x 35° horizontal  
**NAS** Narrow Asymmetric  
**WW** Asymmetric Wallwash

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13 / 14

Type:

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Page 12 of 14

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

## Notes:

### 6 . Lens <sup>(1)</sup>

<b>CL</b>	Clear lens <sup>(2)</sup>
<b>SFR</b>	Small frosted ring <sup>(3)</sup>
<b>LFR</b>	Large frosted ring <sup>(4)</sup>
<b>SL</b>	Softening lens <sup>(5)</sup>

<sup>(1)</sup> Consult Optics and Lens Options section for details.

<sup>(2)</sup> Available for all optics except VN, NAS and WW.

<sup>(3)</sup> Available for NAS and WW optics only.

<sup>(4)</sup> Available for VN optic only.

<sup>(5)</sup> Available as an alternate lens choice for all optics. A softening lens will affect beam distribution and output. Consult factory for application support.

### 9 . Trim Type

<b>FLH</b>	Flush trim with hardware
<b>FLN</b>	Flush trim no hardware <sup>(1)</sup>
<b>BVH</b>	Bevel edge trim with hardware
<b>BVN</b>	Bevel edge trim no hardware <sup>(1)</sup>

<sup>(1)</sup> Not available for DO construction.

### 12 . Options

<b>ASL</b>	Anti-slip lens
<b>HRS</b>	Brass material suitable for harsh environments

### 7 . Optical Options

<b>INTL</b>	Internal louver <sup>(1)</sup>
-------------	--------------------------------

<sup>(1)</sup> Not available for NAS and WW optics.

### 8 . Control <sup>(1)</sup>

<b>NO</b>	On/Off control
<b>LT</b>	Lumentalk <sup>(2)</sup>
<b>DIM</b>	0-10V dimming
<b>DALI</b>	DALI dimming
<b>DMX/RDM</b>	DMX/RDM enabled <sup>(3)</sup>

<sup>(1)</sup> Wattage and output may vary according to control option. Refer to Photometric Summary table for details.

<sup>(2)</sup> A Lumentranslator 2 and LumentalkID (LIDLT) must be specified for Lumentalk applications. Consult Lumentranslator 2 and Lumentalk pages and specification sheets for details.

<sup>(3)</sup> A control box (CBX) and LumenID (LID) must be specified.

### 10 . Trim Finish

<b>SSB</b>	Brushed stainless steel
<b>SSP</b>	Polished stainless steel

### 11 . Blockout

<b>RBO</b>	Recessed blockout
<b>RBM</b>	Recessed blockout with mounting brackets

### 13 . Certification

<b>UL</b>	UL compliant
<b>CE</b>	CE compliant <sup>(1)</sup>

<sup>(1)</sup> Consult European specification sheet and installation instructions for CE wiring information.

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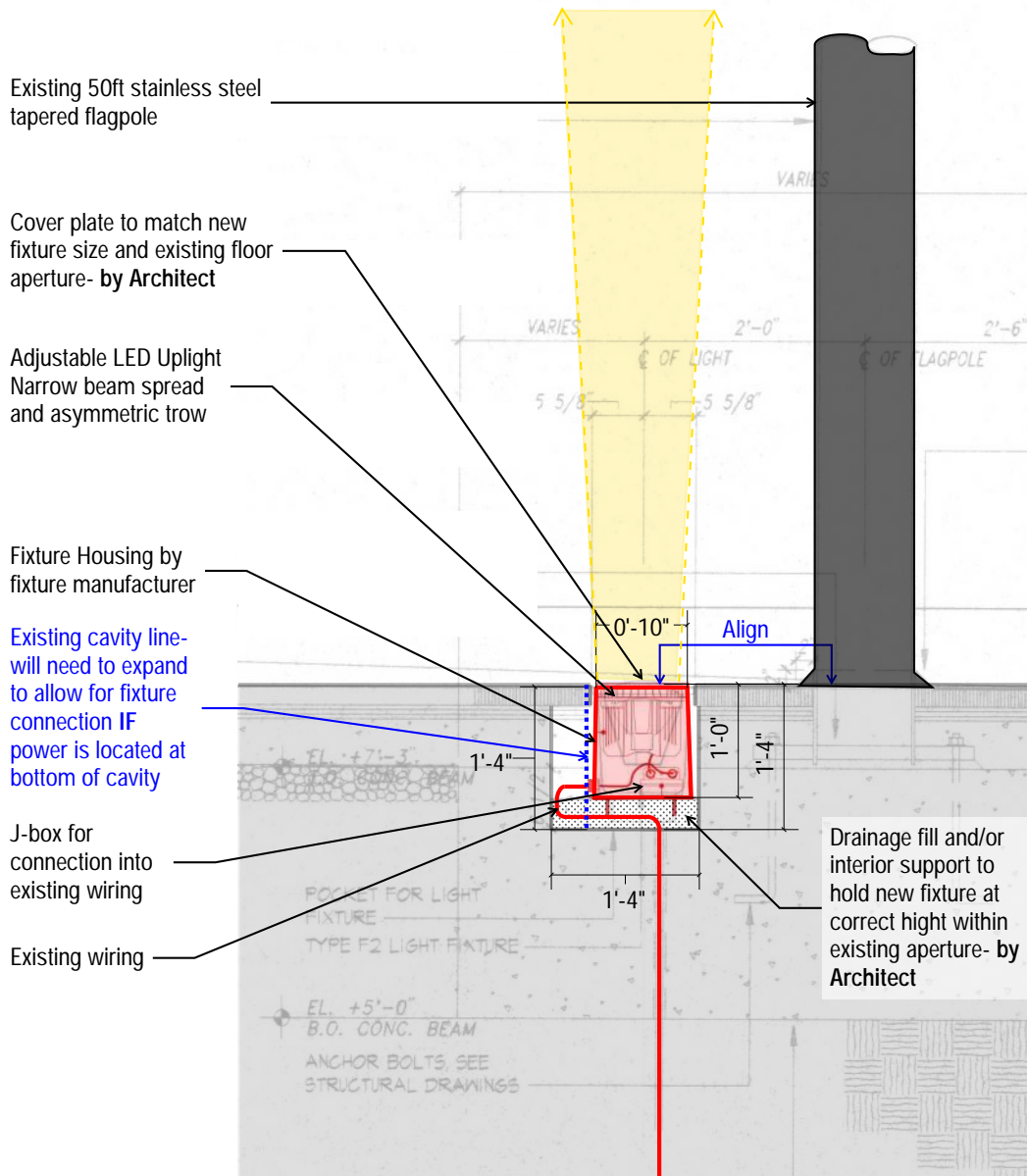
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**R02**

Page 13 of 14

Notes:

**\*FOR DESIGN INTENT ONLY\***



Section- Existing conditions and Proposed Lighting Upgrades  
 Scale: 3/4" = 1'-0"

Type:

**R02**

Page 14 of 14

Specification Sheet / Wall mount / L740 - L48



Type:

Project:

Modified:

Quantity:

Notes:

## L740-L48

**Application** Exterior/Interior wall mount luminaire for illuminating stairs, pathways, and walk ways. Applicable for mounting into walls or where a low profile luminaire is required. ADA compliant. Suitable for wet and dry locations.

**IP Rating** 66

**Mounting** Mounts to single gang box or octagonal junction box. Box opening must be 2 3/8" wide by 2" tall by 1 1/2" depth minimum. (Junction box not included)  
\* See installation sheet.  
Single Gang Box can be purchased from MP Factory ( not included ) \*Refer to page 02

**Electrical** 3W, 12Vdc, 250mA or 6W, 12Vdc, 500mA.

\* consult factory for dimming options.

**Power** 4.0 Watt (At 12Vdc, 250mA, 3 Watt)

**Consumption** 8.0 Watt (At 12Vdc, 500mA, 6 Watt)

**Light Output** 3.0 Watt, 35 lm

6.0 Watt, 56 lm

\*For photometric data, see page 03

**Warranty** 5 years limited warranty

Estimated useful life of LED is 50,000 hours.

**Material** Solid anodized aluminum . RoHS compliant.

**Weight** 1.5lbs (0.68kg).

**Approval** 

### DISCLAIMER

If the fixture has an option to be installed with a dimming control system, consult dimming system manufacturer with minimum load before installing 12V AC transformer.

Malfunction and damage to product due to improper dimming system installation or misuse will not be covered under warranty. Only DC Drivers are recommended for dimming systems. Consult MP Lighting for recommended drivers.

\*MP Lighting reserves the right, at its sole discretion, at any time and without notice, to make design changes to any of our products.

### Order Guide

Example: L740-L48-3-W30-MA

Code	Wattage	Color	Finish
<b>L740-L48</b>	<b>3</b>	<b>W22S</b>	<b>MA</b>
	<b>6</b>	<b>W27S</b>	<b>BK</b>
		<b>W30S</b>	<b>WH</b>
		<b>W35S</b>	<b>BZ</b>
		<b>W41S</b>	
		<b>W27H</b>	
		<b>W30H</b>	
		<b>W35H</b>	

\*Available 120V, other voltage options available, please consult factory

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### Notes:

Recessed LED  
asymmetric step light  
at south ramp

Fixture to be  
NON DIM

MOD mounting plate  
for a 6-1/4" diameter

Provide power  
supply(s) as  
required. Power  
supply(s) to be  
located within J-box

Coordinate leader  
cables, joiners,  
terminators and any  
additional parts as  
required for a  
complete installation

Provide mounting  
brackets as  
necessary to center  
fixture/J-box in  
existing cavity

Existing interior  
dimensions field  
dimensions required  
before fixture  
approval.

Notes continue on  
next page...

- ☐ Standard  
☒ Modified Standard  
☐ Custom  
☐ Sample Required

Manufacturer: **MP LIGHTING**  
Catalog Number: **L740-L48-3-W30S-MA + EBXSGB1 + LED8W350L**

Lamp: 3000K LED (Included)  
Wattage : 3W  
Voltage: 120V  
Finish: Matte Clear Anodized Aluminum, Architect to Confirm

Type:

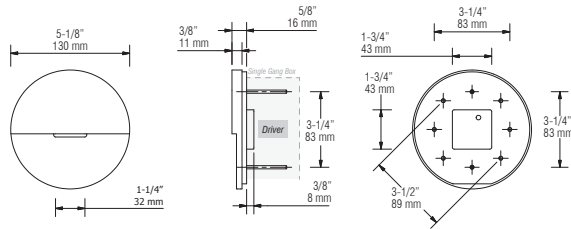
**R03**

Page 1 of 5

☐ Part of Series

Specification Sheet / Wall mount / L740 - L48

**DIMENSION:**



**CUSTOM RECTANGULAR BOXES ORDER GUIDE:**

custom boxes & flange

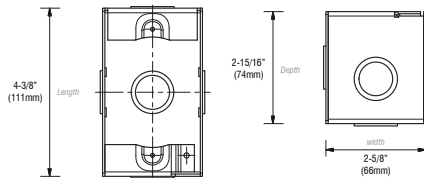
EBX - \_\_\_\_\_

SGB1 = MPLIGHTING Single gang box 1, 4-1/4" (107mm)

SGB = Single gang box, IVERVILLE BCMBD-K, 4-3/4" (122mm)

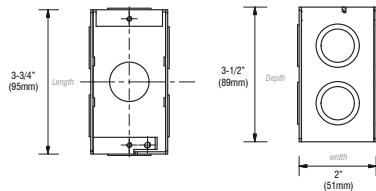
SFD = Scepter / FD BOX-DEEP, 4-1/4" (107mm)

**CUSTOM BOXES:**



SGB1 (MP LIGHTING Single Gang Box 1 - 304 stainless steel)

\*Not included, for inquiry or purchase please consult with MP Factory



SGB (Single Gang Box IBERVILLE BCMBD-K)

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**Notes:**

Requires manufacturer provided shop drawing(s) for approval during shop drawing coordination

Architect to confirm finish

Provide 20% of each type and rating installed for Attic Stock. Furnish at least one of each type.

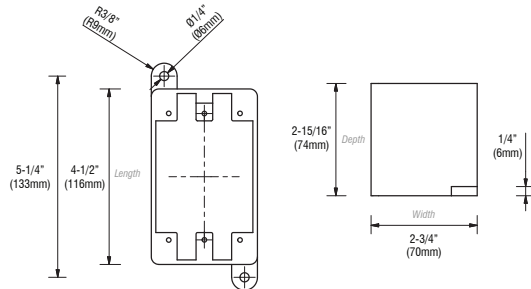
Type:

**R03**

Page 2 of 5

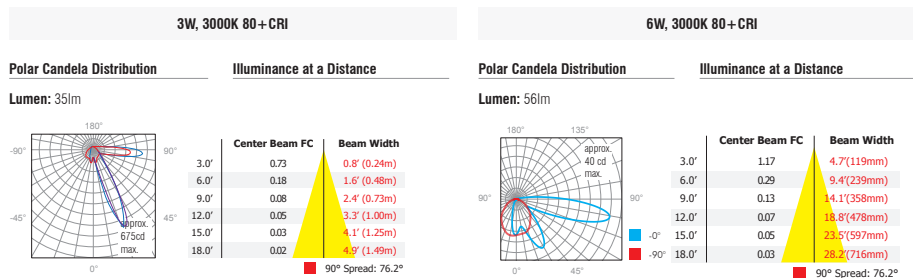
Notes:

Specification Sheet / Wall mount / L740 - L48



SFD (Scepter / FD BOX-DEEP)

PHOTOMETRIC DATA:



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Type:

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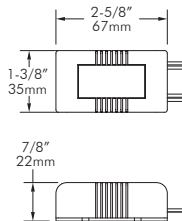
Page 3 of 5

Notes:

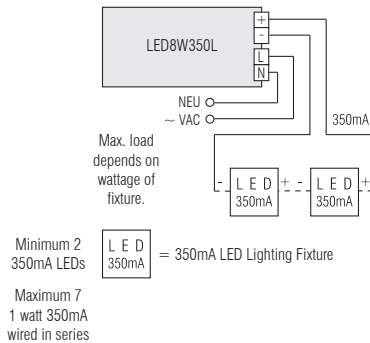
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Dimension:



Driver Diagram:



Specification Sheet

## LED8W350LB LED8W350L

### HIGH POWER CONSTANT CURRENT LED DRIVER

**Features:**

- Compact size that maximizes design flexibility.
- 110, 220, 240 full range AC input.
- Tight regulated constant current output to maximize LED performance.

AC Input Voltage:	100 ~ 240V, 50/60Hz
DC Output Voltage:	3 ~ 36V
<b>DC Output Current:</b>	<b>350mA Constant</b>
Output Wattage:	8W Max
Typical Efficiency:	68%
Short Circuit Protection:	Yes
Overload Protection:	Yes
Dimming Function:	No
Operating Temperature:	-20 ~ 60°C (-4 ~ 140°F)
Maximum Case Temperature:	65°C (149°F)
Humidity (Non-Condensing):	5% ~ 95%
Case Material:	Non Conductive White Plastic
Weight:	89.5g (0.20 lbs)
Approval:	UL



**Note:** Consult factory for maximum wiring length.

**Caution:** Do not install on-off switch at the output (load) side of a constant current LED driver as it will damage the fixture(s).  
Warranty will be void on both driver and fixture(s).

**\*USE WITH EBX-160-ZP ENCLOSURE**

ORDER CODE	ENCLOSURE
<b>LED8W350L</b>	<b>B</b>
	B = drive enclosure (6-1/4" x 5" x 2")

[ Project ]

[ Quantity ]

[ Notes ]

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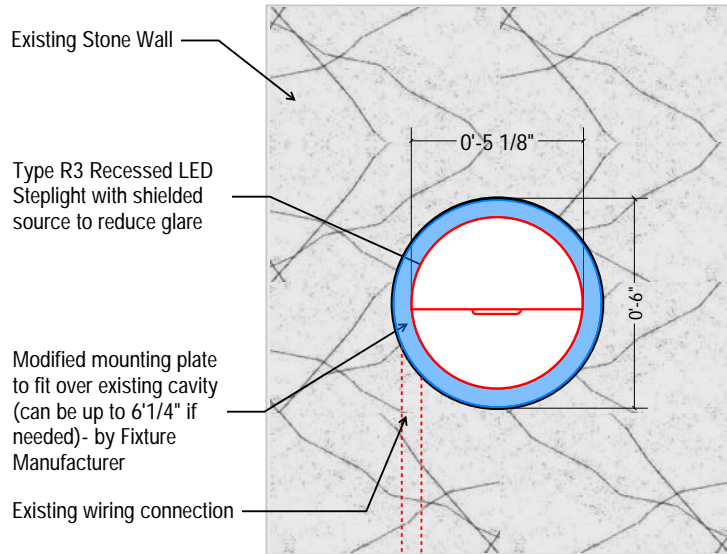
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Type:

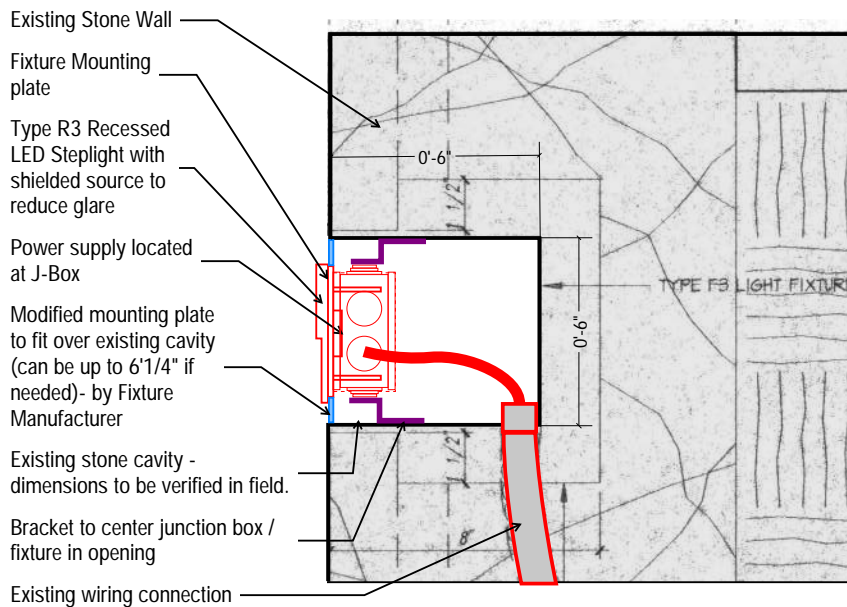
# R03

Page 4 of 5

**\*FOR DESIGN INTENT ONLY\***



Front Elevation Detail - South Entry Ramp Steplights  
 Scale: 3" = 1'-0"



Section Detail - South Entry Ramp Steplights  
 Scale: 3" = 1'-0"

Notes:

Type:

**R03**

Page 5 of 5



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OVERVIEW • SPECIFICATIONS • ORDERING

INTERIOR + EXTERIOR | L50 GRAZE

DATE	PROJECT	FIRM	TYPE
------	---------	------	------

THE L50 INCLUDES PATENTED OPTICAL DESIGN THAT DELIVERS THE WIDEST RANGE OF BEAM ANGLE OPTIONS FOR PRECISE COVE, WALL GRAZING, WALL WASHING OR LINE OF LIGHT APPLICATIONS. EXCLUSIVE FLIP TO FLAT™ HINGE DESIGN PROVIDES FLEXIBILITY WHEN MANAGING SMALL COVE DETAILS. TROV OFFERS SMOOTH, FLICKER FREE DIMMING DOWN TO 0%.

FEATURES :

- DIM TO 0%, ELV REVERSE PHASE
- 24 BEAM ANGLES
- MULTI-VOLT
- FLIP TO FLAT™
- 6 CCT OPTIONS
- 80+ AND 90+ CRI OPTIONS
- IP54 INTERIOR AND IP66 EXTERIOR OPTIONS



MODEL/ SIZE	INTERIOR/ EXTERIOR	LENGTH	POWER	CCT	CRI	VOLTAGE	OPTICS
L50	I E	12" 48"	02 04 06 08 10 12	WHITE CCT 22 27 30 35 40 50	MONO COLOR GR*** BL AM RD***	80 90* Blank For Color	MULT (120-277V)  GRAZING 9 x 9 9 x 17 9 x 29 9 x 59 15 x 15 15 x 23 15 x 35 15 x 65 COVE 120** Asym LINE OF LIGHT LOL

EXAMPLE: L50-I-48-10-27-90-MULT-15x65 \*90 CRI not available in 2200K or 5000K \*\*120 is only available with Exterior option. See L35 spec sheet for interior cove options. \*\*\*Red is not available in 12W or 10W. \*\*\*Green is not available in 12W.

PERFORMANCE	WATTS	OPTIC	LUMEN OUTPUT	EFFICACY
	2W	9'x 29"	110 lm/LF ( 361 lm/m )	55 lm/W
	4W	9'x 29"	302 lm/LF ( 1037 lm/m )	76 lm/W
	6W	9'x 29"	482 lm/LF ( 1614 lm/m )	80 lm/W
	8W	9'x 29"	675 lm/LF ( 2224 lm/m )	84 lm/W
	10W	9'x 29"	785 lm/LF ( 2644 lm/m )	79 lm/W
	12W	9'x 29"	923 lm/LF ( 3109 lm/m )	77 lm/W

ALL LUMEN DATA IS FROM 4000K 80CRI FIXTURES. PLEASE SEE PHOTOMETRY SPEC SHEET FOR ADDITIONAL LUMEN DATA.

COLOR RENDERING INDEX  
COLOR CONSISTENCY  
LUMEN DEPRECIATION / RATED LIFE

80+ 90+  
2-STEP MACADAM ELLIPSE  
WATTS | L70 @ 25C | L70 @ 50C | L90 @ 25C | L90 @ 50C

2W-12W | >150,000 | >70,000 | >50,000 | >25,000 \*CALCULATIONS FOR LED FIXTURES ARE BASED ON MEASUREMENTS THAT COMPLY WITH IES LM-80 TESTING PROCEDURES AND IES TM-21 CALCULATOR

ELECTRICAL	POWER CONSUMPTION	2W/LF (6.6W/M) ; 4W/LF (13.2W/M) ; 6W/LF (19.8W/M) ; 8W/LF (26.4W/M) ; 10W/LF (33W/M) ; 12W/LF (39.6W/M) * 3W/LF (9.9W/M) at 220V -277V
	MAX FIXTURE RUN LENGTH	
	POWER FACTOR	4W, 6W, 8W, 10W, 12W >0.9, 2W<0.9
	OPERATING VOLTAGE	MULTIVOLT: 110-277VAC, 50/60 Hz
	DRIVER	INTEGRAL TO FIXTURE; DE-RATED POWER AND SYNCHRONOUS START-UP AT FULL BRIGHTNESS
	STARTUP TEMPERATURE	-40°F TO 122°F (-40°C TO 50°C)
	OPERATING TEMPERATURE	-40°F TO 122°F (-40°C TO 50°C)
	STORAGE TEMPERATURE	-40°F TO 176°F (-40°C TO 80°C)

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1/3

Notes:

Surface mounted  
linear LED adjustable  
9x29 degree grazing  
uplight fixture at  
memorial wall

Requires ELV  
dimming controls

Coordinate leader  
cables, joiners,  
terminators and any  
additional parts as  
required for a  
complete installation

Provide fixture with  
Fine adjustment  
bracket as required

Fixtures are to be  
mounted end to end  
without gaps using  
longest module units  
possible to form  
continuous rows.  
Allow 6" offset from  
both ends.

Note 4ft fixtures  
require (2) fine  
adjustment brackets  
each.

Notes continue on  
next page...

- ☒ Standard  
☐ Modified Standard  
☐ Custom  
☐ Sample Required

Manufacturer: ECOSENSE LIGHTING  
Catalog Number: L50-E-(12"-48")-12-30-80-MULT-9x29 + MNT-L-FAB (AS REQUIRED)  
+ CBL-3P-L-UNV-10 + CBL-3P-L-UNV-01 (JUMPERS AS REQUIRED)  
Lamp: 3000K LED (Included)  
Wattage : 12W/LF  
Voltage: 120V  
Finish: Manufacturer Standard Aluminum, Architect to Confirm

Type:

R04

Page 1 of 8

☐ Part of Series

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OVERVIEW • SPECIFICATIONS • ORDERING

INTERIOR + EXTERIOR | L50 GRAZE

DATE	PROJECT	FIRM	TYPE
CONTROL	DIMMING	110-277VAC, ELV TYPE 0.07%-100%, REVERSE PHASE, TRAILING EDGE ETC control systems require 0-10V control using Ecosense LDCM. TROV will not work with ETC phase dimmers.	
PHYSICAL	DIMENSIONS	W 1.6" x H 2" x L 12"/48" : (41.6mm x 50.5mm x 304.7mm/1201mm)	
	HOUSING / LENS	EXTRUDED ALUMINUM; UV STABILIZED POLYCARBONATE; STAINLESS STEEL FASTENERS; PLASTIC ENDCAPS RUBBER OVERMOLD FOR CABLE ASSEMBLY	
	WEIGHT	1.52LBS / 0.69KG (1FT) ; 4.95LBS / 2.25KG (4FT)	
	CONNECTORS	INTEGRAL MALE / FEMALE CONNECTORS	
ENVIRONMENT	INDOOR	ETL CERTIFIED FOR DRY/DAMP LOCATIONS IP54	
	OUTDOOR	ETL CERTIFIED FOR WET LOCATIONS IP66	
BEAM ANGLE	IMPACT RATED	TO IK10	
	Not intended to be used in water features such as waterfalls, fountains, etc.		
	GRAZING, WASHING, COVE, ASYMMETRIC, LINE OF LIGHT		
MOUNTING OPTIONS		INTEGRAL MOUNTING AND ADJUSTABLE AIMING FROM 0°-180° IN 15° INCREMENTS	
FIXTURE RATING & CERTIFICATIONS	CE, ETL CERTIFIED		
	RoHS COMPLIANT		
	ENERGY STAR COMPLIANT		
	RCM CERTIFIED		

LIMITED WARRANTY 5 YEARS

#### WIRING OPTIONS (MVOLT): 110-277VAC

Power Cable Assembly, TROV, Leader/Jumper, 10 foot.....	CBL-3P-L-UNV-10*
Power Cable Assembly, TROV, Leader/Jumper, 50 foot.....	CBL-3P-L-UNV-50*
Power Cable Assembly, TROV, Jumper, 5 foot.....	CBL-3P-L-UNV-05**
Power Cable Assembly, TROV, Jumper, 1 foot.....	CBL-3P-L-UNV-01**
Power Cable Assembly, TROV, Adjustable Jumper, 0" to 7".....	CBL-3P-L-UNV-ADJ
Power Cable Assembly, TROV, Male and Female terminator caps.....	CBL-3P-L-UNV-CAPS

\*Two (2) terminators are included with the 10' and 50' power cable. One Leader need per circuit/fixture run. Cables are not plenum rated.

\*\* If using the 5' or 1' power cable assembly as a leader to power a run one set of CBL-3P-L-UNV-CAPS will also be need per cable.

#### 0-10V CONTROL OPTIONS

100-120VAC / 277VAC Linear Dimming Control Module 0-10V - Plenum Rated..... LDCM-PL-120-277-010V-GR

All products come standard with ELV dimming capabilities. 0-10V Control options required for operation at 0-10V.

#### OPTIONAL ACCESSORIES

##### Mounting

Mounting Track and Clips Set, 48 Inch Track, 8 Clips.....	MNT-L-TRKCLIP-48	48" track and clips set will work with one 48" fixture or four 12" fixtures.
Mounting Track and Clips Set, 12 Inch Track, 2 Clips.....	MNT-L-TRKCLIP-12	12" track will not work with 48" fixtures.
Mounting Track Clip, TROV, Set of 2.....	MNT-L-CLIP	Clips needed = 12" fixtures need 1 set of 2 and 48" fixture needs 2 sets of 2.
90 Degree L bracket, TROV, Set of 2.....	MNT-L-LBKT	L-Brackets needed = 12" fixtures need 1 set of 2 and 48" fixture needs 1 set of 2.
Angle Locking Clip, TROV, Pack of 10.....	MNT-L-ANGLOCK	Angle Locks needed = 12" fixtures need 1 and 48" fixtures need 2. (Must order separately)
Mounting, Fine Adjustment Bracket, TROV.....	MNT-L-FAB	Fine Adjustment Brackets needed = 12" fixtures need 1 and 48" fixtures need 2.
*Fine Adjustment Bracket is highly recommended for Grazing Optics.		
Mounting, Fine Adjustment L-Bracket, TROV.....	MNT-L-LFAB	Fine Adjustment L-Brackets needed = 12" fixtures need 1 and 48" fixtures need 2.
*Fine Adjustment L-Bracket is recommended for Asymetric Optics when aiming is needed.		

##### Snap-on Lenses

Snap-on Lens, Frosted, 12 inch, L50.....	LENS-L50-FROST-12	Snap-on Lenses need = One 12" lens is needed per 12" fixture and one 48" lens is needed per 48" fixture. Snap on Lenses will not work with the asymmetric fixture. Clear lenses can be used to hold colored filters to customize the output color of any TROV fixture, except the ASYM. Color filters supplied by others.
Snap-on Lens, Frosted, 48 inch, L50.....	LENS-L50-FROST-48	
Snap-on Lens, Clear, 12 inch, L50.....	LENS-L50-CLEAR-12	
Snap-on Lens, Clear, 48 inch, L50.....	LENS-L50-CLEAR-48	

##### Wall Mount Arm

Wall Mount Arm, 6 inch, TROV.....	WMA-L-CA-06	Wall Mount Arms needed = For individual fixture installations two arms and one end set will be needed per fixture. For continuous run installation one endset will be needed per run. Each end set contains one left and one right end plate. One joining set will be needed per joint. One arm per fixture will be need plus one extra arm to complete the run. For example: A 10ft run made with two 4ft and two 1ft fixtures will contain; 1 x WMA-L-END, 3 x WMA-L-JNR, and 5 x WMA-L-CA-12. Leader cables are not included with wall mount arms, end sets, or joiners sets.
Wall Mount Arm, 12 inch, TROV.....	WMA-L-CA-12	
Wall Mount Arm, 18 inch, TROV.....	WMA-L-CA-18	
Wall Mount Arm, 24 inch, TROV.....	WMA-L-CA-24	
Wall Mount Arm End Plate Set, TROV, Includes Left and Right.....	WMA-L-END	
Wall Mount Arm Joiner Plate, TROV.....	WMA-L-JNR	

##### Louvers

Louver, Asymmetric, 12 inch, L50.....	LV-L50-ASYM-12	Louvers Needed = One 12" louver is needed per 12" fixture and one 48" louver is needed per 48" fixture. 48" louver is made up of four 12" louvers. Louvers cannot be used with the asymmetric fixture
Louver, Asymmetric, 48 inch, L50.....	LV-L50-ASYM-48	
Louver, Symmetric, 12 inch, L50.....	LV-L50-SYM-12	
Louver, Symmetric, 48 inch, L50.....	LV-L50-SYM-48	
Louver, Honeycomb, 12 inch, L50.....	LV-L50-HCOMB-12	
Louver, Honeycomb, 48 inch, L50.....	LV-L50-HCOMB-48	

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#### Notes:

Provide 20% of each type and rating installed for Attic Stock. Furnish at least one of each type.

Provide 0-10V control module LDCM-PL-120-277-0 10V-GR if required per Lighting Control panel specification

Type:

R04

Page 2 of 8

Notes:

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OVERVIEW • SPECIFICATIONS • ORDERING

INTERIOR + EXTERIOR | L50 GRAZE

DATE	PROJECT	FIRM	TYPE
------	---------	------	------

**OPTIONAL ACCESSORIES**

**Masking Plates**

Masking Plate, 3 inch high, 12 inch, L50 & L35 ..... MP-L50-3H-12  
Masking Plate, 3 inch high, 48 inch, L50 & L35 ..... MP-L50-3H-48  
Masking Plates needed = One 12" lens is needed per 12" fixture and one 48" lens is needed per 48" fixture.

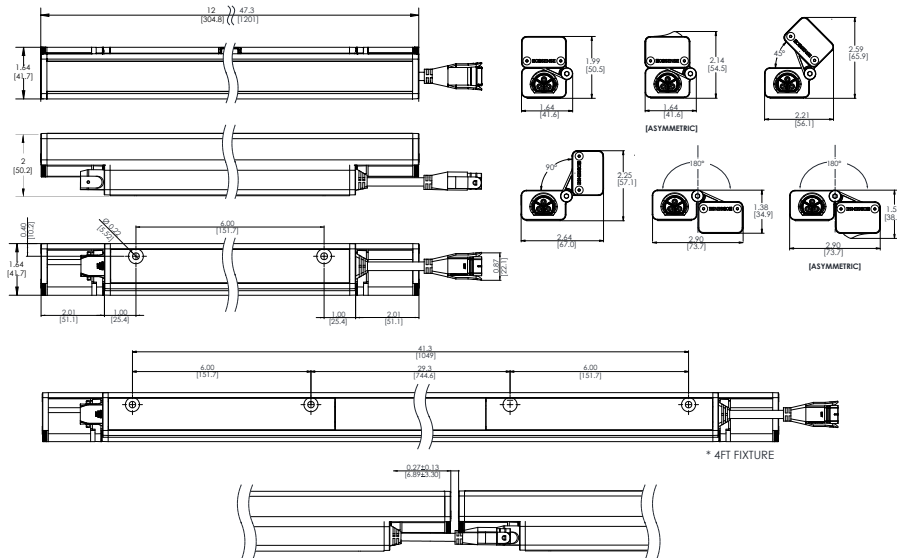
**Landscape Stake**

Landscape Stake, 6 inch, TROV, Set of 2 ..... LS-L-STK-06  
Landscape Stake, 12 inch, TROV, Set of 2 ..... LS-L-STK-12  
Landscape Stake, 18 inch, TROV, Set of 2 ..... LS-L-STK-18  
Landscape Stakes needed = 12" and 48" fixtures both need one set of 2.

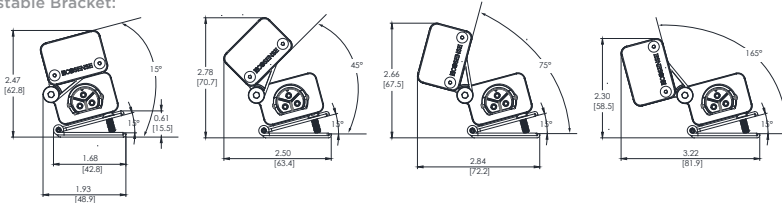
**Wire Box**

Conduit Connection, Wire Box, TROV, Interior Only, L50 ..... CC-L-WIREBOX  
Wire box can be used instead of a leader cable to start a run. 1/2" conduit fitting can attach directly to the box on one end and the fixture to the other.

**DIMENSIONS + MOUNTING**



**Fine Adjustable Bracket:**



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Type:

R04

Page 3 of 8

Notes:

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TRÖV

OVERVIEW • SPECIFICATIONS

ACCESSORIES | FINE ADJUSTMENT BRACKET

DATE	PROJECT	FIRM	TYPE
------	---------	------	------

TROV FINE ADJUSTMENT BRACKETS ARE IDEAL FOR APPLICATIONS THAT REQUIRE ANGLE ADJUSTMENTS SMALLER THAN 15° AND ARE HIGHLY RECOMMENDED FOR WALL GRAZING APPLICATIONS

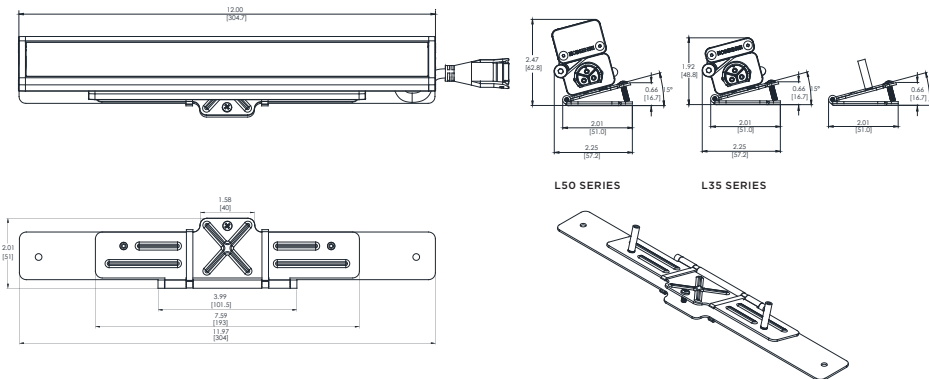
**FEATURES :**

- COMPATIBLE WITH L35 AND L50 SERIES FIXTURES
- FINE ADJUSTABLE BRACKET CAN BE SET TO ANY ANGLE FROM 1° TO 15 °



PHYSICAL	DIMENSIONS MATERIAL	W 1.68" x H 0.61" x L 12" : (42.8mm x 15.5mm x 304.7mm) APPROX CLEAR ANODIZED ALUMINUM
----------	------------------------	---

FINE ADJUSTMENT BRACKET for L35 AND L50



ORDERING

PART NUMBER	DESCRIPTION
MNT-L-FAB	TROV FINE ADJUSTMENT BRACKET

LIMITED WARRANTY 5 YEARS

ECOSENSE LIGHTING INC. 915 WILSHIRE BLVD SUITE 2175 LOS ANGELES, CA 90017	P • 310.496.6255 F • 310.496.6256 T • 855.632.6736 855.6.ECOSEN	SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE. VISIT <a href="http://ECOSENSELIGHTING.COM">ECOSENSELIGHTING.COM</a> FOR THE MOST CURRENT SPECIFICATIONS. © 2015 ECOSENSE LIGHTING INC. ALL RIGHTS RESERVED. ECOSENSE, THE ECOSENSE LOGO AND ECOSPEC ARE REGISTERED TRADEMARKS OF ECOSENSE LIGHTING INC.	ECOSENSELIGHTING.COM	1
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Type:

R04

Page 4 of 8

Notes:

ECOSENSE®

TRÖV

INSTALLATION GUIDE

ACCESSORIES | Fine Adjustment Bracket



EcoSense Lighting Fixtures must be installed by a qualified electrician. EcoSense Lighting, Inc. is not responsible if its fixtures are not installed in accordance with all national and local safety standards.

#### INCLUDED IN BOX

#### Fine Adjustment Bracket (FAB) Installation Guide

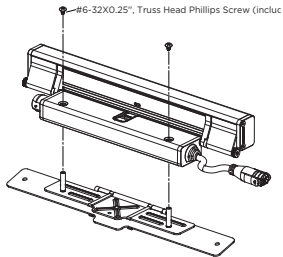
#### NOTE

• One FAB required for 1ft and two required for 4ft Fixture. FAB works the same for L35 and L50.

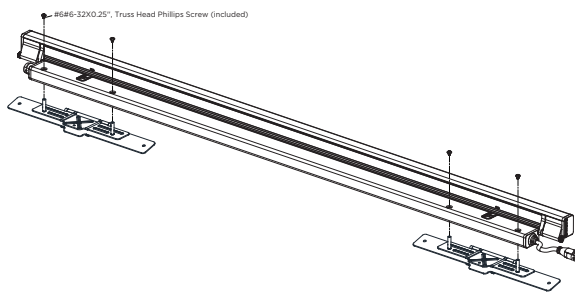
### INSTALL THE FIXTURES

#### Step 1: Mount Fixture to FAB(S)

- Use the #6-32 screws (2 included per FAB)

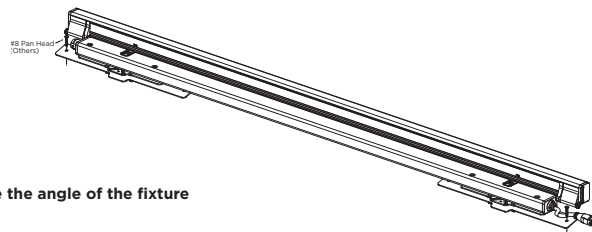
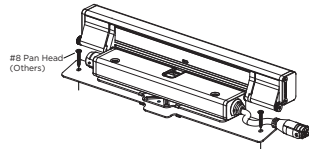


Ensure power is OFF



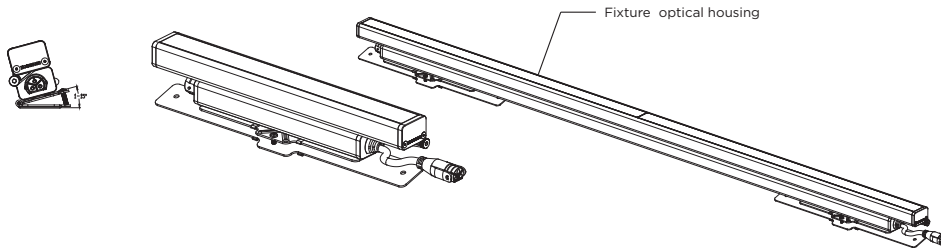
#### Step 2: Mount FAB to surface.

- Use 2 #8 screws per fixture.



#### Step 3: Turn adjustment screw to change the angle of the fixture

- Adjusts angle from 1° to 15°
- If a greater angle is required, rotate the fixture optical housing. Each 'Click' represents 15°



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1

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R04

Page 5 of 8

# ECOSENSE<sup>®</sup>

OVERVIEW • SPECIFICATIONS • ORDERING

# ECOSPEC<sup>™</sup>

ACCESSORIES | LDCM

DATE	PROJECT	FIRM	TYPE
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ECOSPEC<sup>®</sup> LINEAR DIMMING CONTROL MODULE PLENUM RATED (LDCM-PL) TAKES A 0-10V DIMMING SIGNAL AND A FIXED LINE VOLTAGE INPUT AND CONVERTS IT TO A REVERSE PHASE DIMMED OUTPUT FOR UP TO 1000W WITH A 277V LOAD AND 450W ON A 120V LOAD. ONE LDCM CAN BE USED PER RUN UP TO THE MAXIMUM WATTAGE. THE LDCM-PL IS RATED TO DIRECTLY MOUNT TO A JUNCTION BOX IN A PLENUM SPACE FOR EASIER INSTALLATIONS AND TO MEET BUILDING REQUIREMENTS.

## FEATURES :

- DIMS REVERSE PHASE ONLY FIXTURES WITH 0-10V
- SIMPLE INSTALLATION
- DIRECT J-BOX MOUNT
- 120V AND 277V COMPATIBLE
- AUTO-SENSING VOLTAGE SWITCH
- 450W @120V, 1000W @277V
- PLENUM RATED
- ONE LDCM PER FIXTURE RUN

FOR USE WITH ECOSENSE<sup>®</sup> PRODUCTS **ONLY**, WARRANTY ONLY VALID WHEN USED WITH ECOSENSE LIGHTING PRODUCTS. FOR MORE INFORMATION ON TESTING YOUR PRODUCT WITH THE ECOSENSE LDCM PLEASE EMAIL [INFO@ECOSENSELIGHTING.COM](mailto:INFO@ECOSENSELIGHTING.COM).



MODEL	VOLTAGE	CONTROL	COLOR
LDCM-PL	<b>120-277</b> 110VAC-120VAC, 277V Auto-Sensing Voltage Switch	<b>010V</b> - 0 - 10V	<b>GR</b> - Grey

**EXAMPLE:** LDCM-PL - 120-277 - 010V - GR

ELECTRICAL	POWER RATING	450W MAX @ 110-120V 1000W MAX @ 277V
	MAX FIXTURE RUN LENGTH	CALCULATE MAXIMUM RUN PER LDCM UNIT BASED ON THE POWER CONSUMPTION OF THE FIXTURE USED
	OPERATING VOLTAGE	110VAC-120VAC, 277VAC - AUTO-SENSING VOLTAGE SWITCH
	OPERATING HERTZ	60 Hz
	STARTUP TEMPERATURE	-4°F TO 104°F (-20°C TO 40°C)
	OPERATING TEMPERATURE	-4°F TO 104°F (-20°C TO 40°C)
	STORAGE TEMPERATURE	-4°F TO 176°F (-40°C TO 80°C)
CONTROL	DIMMING	110-120VAC; REVERSE PHASE; CONVERTED FROM 0-10V CONTROLLER 277VAC; REVERSE PHASE; CONVERTED FROM 0-10V CONTROLLER
PHYSICAL	DIMENSIONS	W 3.4" x H 2" x L 7" ; (87mm x 50mm x 178mm)
	HOUSING / LENS	INJECTION MOLDED POLYCARBONATE
	CONNECTORS	LEAD WIRE 6" FROM CONDUIT
	WEIGHT	0.99 LBS (0.45 KG)
	ENVIRONMENT	ETL DAMP LOCATION
	MOUNTING OPTIONS:	CONDUIT MOUNTING FOR BOTH SIDES
RATING & CERTIFICATIONS	ETL/cETL DAMP LOCATIONS	<div> Intertek</div> <div> COMPLIANT</div>
ECOSENSE LIGHTING INC. 837 NORTH SPRING STREET SUITE 103 LOS ANGELES, CA 90012		<div><p>P • 310.496.6255 F • 310.496.6256 T • 855.632.6736 855.6. ECOSEN</p><p><small>SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE. VISIT <a href="http://ECOSENSELIGHTING.COM">ECOSENSELIGHTING.COM</a> FOR THE MOST CURRENT SPECIFICATIONS. FOR A LIST OF PATENTS VISIT <a href="http://ECOSENSELIGHTING.COM/IP-PORTFOLIO/">ECOSENSELIGHTING.COM/IP-PORTFOLIO/</a> ©2018 ECOSENSE LIGHTING INC. ALL RIGHTS RESERVED. ECOSENSE, THE ECOSENSE LOGO, TRIO, TRIOV AND ECOSPEC ARE REGISTERED TRADEMARKS OF ECOSENSE LIGHTING INC. RISE<sup>®</sup>, SLIM COVE<sup>™</sup>, FREEDOM TO CREATE<sup>™</sup>, MACRO<sup>®</sup>, FLIP-TO-FLAT<sup>™</sup> ARE TRADEMARKS OF ECOSENSE LIGHTING INC.</small></p></div>
		<div><a href="http://ECOSENSELIGHTING.COM">ECOSENSELIGHTING.COM</a></div> <div>1/2</div>

Notes:

Type:

**R04**

Page 6 of 8

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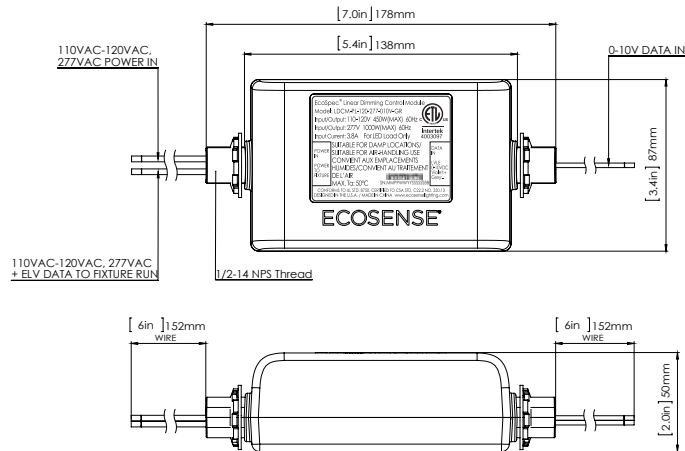
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ECOSPEC™

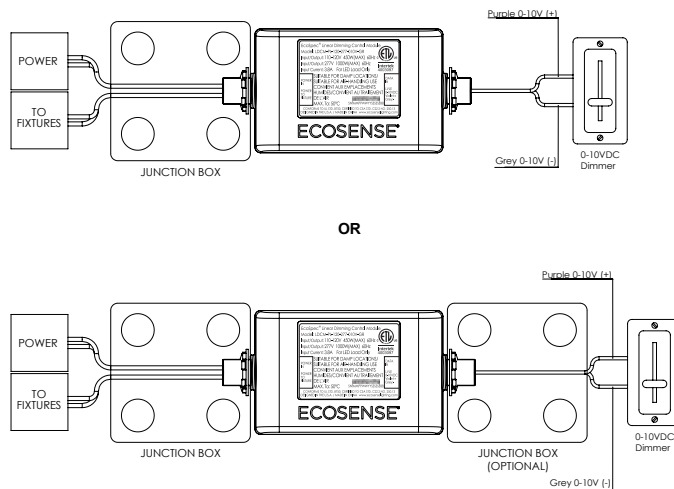
ACCESSORIES | LDCM

DATE	PROJECT	FIRM	TYPE
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DIMENSIONS



CONNECTIONS



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Notes:

Type:

R04

Page 7 of 8



**\*FOR DESIGN INTENT ONLY\***

Notes:

Additional regressed cross-grate near wall helps reduce any over-bright areas at lower wall and provides possible place for flowers/memorial items- **by Architect**

New S.S. grate running perpendicular to granite wall. Depth of grate to be determined by cutoff needed for glare reduction - **by Architect**

Architect to confirm regressed dimension

Fine adjustment mounting bracket

Drain depth at the end of the wall

Max. drain depth

Solid section at front of grate further reduces view of fixture & glare - **by Architect**

Type R04: 9°x29° Narrow beam

Type R04-A: 40°x40° optic

Mounting profile for light fixture- **by Architect**

Trench Detail Section  
 Scale: 3" = 1'-0"

Type:

**R04**

Page 8 of 8



ECOSENSE®

TRÖV®

OVERVIEW • SPECIFICATIONS • ORDERING

INTERIOR + EXTERIOR | L50 WASH

DATE	PROJECT	FIRM	TYPE
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THE L50 INCLUDES PATENTED OPTICAL DESIGN THAT DELIVERS THE WIDEST RANGE OF BEAM ANGLE OPTIONS FOR PRECISE COVE, WALL GRAZING, WALL WASHING OR LINE OF LIGHT APPLICATIONS. EXCLUSIVE FLIP TO FLAT™ HINGE DESIGN PROVIDES FLEXIBILITY WHEN MANAGING SMALL COVE DETAILS. TROY OFFERS SMOOTH, FLICKER FREE DIMMING DOWN TO 0%.

**FEATURES :**

- DIM TO 0%, ELV REVERSE PHASE
- 24 BEAM ANGLES
- MULTI-VOLT
- FLIP TO FLAT™
- 6 CCT OPTIONS
- 80+ AND 90+ CRI OPTIONS
- IP54 INTERIOR AND IP66 EXTERIOR OPTIONS



MODEL/ SIZE	INTERIOR/ EXTERIOR	LENGTH	POWER	CCT	CRI	VOLTAGE	OPTICS
L50	I E	12" 48"	02 04 06 08 10 12	WHITE CCT 22 27 30 35 40 50	MONO COLOR GR**** BL AM RD***	80 90* Blank For Color	MULT (120-277V)  GRAZING 9 x 9 9 x 17 9 x 29 9 x 59 15 x 15 15 x 23 15 x 35 15 x 65 COVE 120** Asym LINE OF LIGHT LOL

**EXAMPLE:** L50-I-48-10-27-90-MULT-15x65 \*90 CRI not available in 2200K or 5000K \*\*120 is only available with Exterior option. See L35 spec sheet for interior cove options. \*\*\*Red is not available in 12W or 10W. \*\*\*\*Green is not available in 12W.

PERFORMANCE	WATTS	OPTIC	LUMEN OUTPUT	EFFICACY
	2W	40° x 60°	110 lm/LF ( 361 lm/m )	55 lm/W
	4W	40° x 60°	302 lm/LF ( 1037 lm/m )	76 lm/W
	6W	40° x 60°	482 lm/LF ( 1614 lm/m )	80 lm/W
	8W	40° x 60°	675 lm/LF ( 2224 lm/m )	84 lm/W
	10W	40° x 60°	785 lm/LF ( 2644 lm/m )	79 lm/W
	12W	40° x 60°	923 lm/LF ( 3201 lm/m )	77 lm/W

ALL LUMEN DATA IS FROM 4000K 80CRI FIXTURES. PLEASE SEE PHOTOMETRY SPEC SHEET FOR ADDITIONAL LUMEN DATA.

COLOR RENDERING INDEX	80+, 90+
COLOR CONSISTENCY	2-STEP MACADAM ELLIPSE
LUMEN DEPRECIATION / RATED LIFE	WATTS   L70 @ 25C   L70 @ 50C   L90 @ 25C   L90 @ 50C
	2W-12W   >10,000   >70,000   >50,000   >25,000

\* CALCULATIONS FOR LED FIXTURES ARE BASED ON MEASUREMENTS THAT COMPLY WITH IES LM-80 TESTING PROCEDURES AND IES TM-21 CALCULATOR

ELECTRICAL

POWER CONSUMPTION

MAX FIXTURE RUN LENGTH

POWER FACTOR

OPERATING VOLTAGE

DRIVER

STARTUP TEMPERATURE

OPERATING TEMPERATURE

STORAGE TEMPERATURE

2W/LF (6.6W/M); 4W/LF (13.2W/M); 6W/LF (19.8W/M); 8W/LF (26.4W/M); 10W/LF (33W/M); 12W/LF (39.6W/M)

\* 3W/LF (9.9W/M) at 220V -277V

	2W/LF		4W/LF		6W/LF		8W/LF		10W/LF		12W/LF	
Volts	Max Run all 1'	Max Run all 4'	Max Run all 1'	Max Run all 4'	Max Run all 1'	Max Run all 4'	Max Run all 1'	Max Run all 4'	Max Run all 1'	Max Run all 4'	Max Run all 1'	Max Run all 4'
120	214	214	186	186	152	152	114	114	91	91	76	76
220	374	392	340	340	277	277	209	209	95	167	95	139
277	374	494	374	428	349	349	263	263	95	190	95	175

4W, 6W, 8W, 10W, 12W >0.9, 2W<0.9

MULTIVOLT: 110-277VAC, 50/60 Hz

INTEGRAL TO FIXTURE; DE-RATED POWER AND SYNCHRONOUS START-UP AT FULL BRIGHTNESS

-40° F TO 122° F (-40° C TO 50° C)

-40° F TO 122° F (-40° C TO 50° C)

-40° F TO 176° F (-40° C TO 80° C)

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1/3

20190415

**Notes:**

Surface mounted  
linear LED adjustable  
40x40 degree grazing  
uplight fixture at  
memorial wall

Requires ELV  
dimming controls or  
signal from  
ELV/0-10V control  
module for 0-10V  
control.

Coordinate leader  
cables, joiners,  
terminators and any  
additional parts as  
required for a  
complete installation

Provide fixture with  
Fine adjustment  
bracket as required  
Note 4ft fixtures  
require (2) fine  
adjustment brackets  
each.

Fixtures are to be  
mounted end to end  
without gaps using  
longest module units  
possible to form  
continuous rows.  
Allow 6" offset from  
both ends.

Notes continue on  
next page...

- ☒ Standard  
☐ Modified Standard  
☐ Custom  
☐ Sample Required

Manufacturer: ECOSENSE LIGHTING  
Catalog Number: L50-E-(12"-48")-12-30-80-MULT-40x40 + MNT-L-FAB (AS REQUIRED)  
+ CBL-3P-L-UNV-10 + CBL-3P-L-UNV-01 (JUMPERS AS REQUIRED)  
Lamp: 3000K LED (Included)  
Wattage : 12W/LF  
Voltage: 120V  
Finish: Manufacturer Standard Aluminum, Architect to Confirm

Type:

R04-A

Page 1 of 8






☐ Part of Series

ECOSENSE®

TROV®

OVERVIEW • SPECIFICATIONS • ORDERING

INTERIOR + EXTERIOR | L50 WASH

DATE	PROJECT	FIRM	TYPE
CONTROL	DIMMING	110-277VAC, ELV TYPE 0.07%-100%, REVERSE PHASE, TRAILING EDGE ETC control systems require 0-10V control using EcoSense LDCM. TROV will not work with ETC phase dimmers.	
PHYSICAL	DIMENSIONS	W 1.6" x H 2" x L 12"/48"; (41.6mm x 50.5mm x 304.7mm/1201mm)	
	HOUSING / LENS	EXTRUDED ALUMINUM; UV STABILIZED POLYCARBONATE; STAINLESS STEEL FASTENERS; PLASTIC ENDCAPS RUBBER OVERMOLD FOR CABLE ASSEMBLY 1.52LBS / 0.69KG (1FT); 4.95LBS / 2.25KG (4FT)	
	WEIGHT	INTEGRAL MALE/ FEMALE CONNECTORS	
	CONNECTORS	INDOOR • ETL CERTIFIED FOR DRY/DAMP LOCATIONS IP54 OUTDOOR • ETL CERTIFIED FOR WET LOCATIONS IP66	
	ENVIRONMENT	IMPACT RATED TO IK10 Not intended to be used in water features such as waterfalls, fountains, etc. GRAZING, WASHING, COVE, ASYMMETRIC, LINE OF LIGHT INTEGRAL MOUNTING AND ADJUSTABLE AIMING FROM 0°-180° IN 15° INCREMENTS	
	BEAM ANGLE		
	MOUNTING OPTIONS		
FIXTURE RATING & CERTIFICATIONS	CE, ETL CERTIFIED	    	
	RoHS COMPLIANT		
	ENERGY STAR COMPLIANT		
	RCM CERTIFIED		
LIMITED WARRANTY	5 YEARS		

#### WIRING OPTIONS (MVOLT): 110-277VAC

Power Cable Assembly, TROV, Leader/Jumper, 10 foot.....	CBL-3P-L-UNV-10*
Power Cable Assembly, TROV, Leader/Jumper, 50 foot.....	CBL-3P-L-UNV-50*
Power Cable Assembly, TROV, Jumper, 5 foot.....	CBL-3P-L-UNV-05**
Power Cable Assembly, TROV, Jumper, 1 foot.....	CBL-3P-L-UNV-01**
Power Cable Assembly, TROV, Male and Female terminator caps.....	CBL-3P-L-UNV-CAPS

\*Two (2) terminators are included with the 10' and 50' power cable. One Leader need per circuit/fixture run. Cables are not plenum rated.  
\*\* If using the 5' or 1' power cable assembly as a leader to power a run one set of CBL-3P-L-UNV-CAPS will also be need per cable.

#### 0-10V CONTROL OPTIONS

100-120VAC / 277VAC Linear Dimming Control Module 0-10V - Plenum Rated .....	LDCM-PL-120-277-010V-GR
--	-------------------------

All products come standard with ELV dimming capabilities. 0-10V Control options required for operation at 0-10V.

#### OPTIONAL ACCESSORIES

##### Mounting

Mounting Track and Clips Set, 48 Inch Track, 8 Clips.....	MNT-L-TRKCLIP-48	48" track and clips set will work with one 48" fixture or four 12" fixtures.
Mounting Track and Clips Set, 12 Inch Track, 2 Clips.....	MNT-L-TRKCLIP-12	12" track will not work with 48" fixtures.
Mounting Track Clip, TROV, Set of 2.....	MNT-L-CLIP	Clips needed = 12" fixtures need 1 set of 2 and 48" fixture needs 2 sets of 2.
90 Degree L bracket, TROV, Set of 2.....	MNT-L-LBKT	L-Brackets needed = 12" fixtures need 1 set of 2 and 48" fixture needs 1 set of 2.
Angle Locking Clip, TROV, Pack of 10.....	MNT-L-ANGLOCK	Angle Locks needed = 12" fixtures need 1 and 48" fixtures need 2. (Must order separately)
Mounting, Fine Adjustment Bracket, TROV.....	MNT-L-FAB	Fine Adjustment Brackets needed = 12" fixtures need 1 and 48" fixtures need 2.
*Fine Adjustment Bracket is highly recommended for Grazing Optics.		
Mounting, Fine Adjustment L-Bracket, TROV.....	MNT-L-LFAB	Fine Adjustment L-Brackets needed = 12" fixtures need 1 and 48" fixtures need 2.
*Fine Adjustment L-Bracket is recommended for Asymmetric Optics when aiming is needed.		

##### Snap-on Lenses

Snap-on Lens, Frosted, 12 inch, L50.....	LENS-L50-FROST-12	Snap-on Lenses need = One 12" lens is needed per 12" fixture and one 48" lens is needed per 48" fixture. Snap on Lenses will not work with the asymmetric fixture. Clear lenses can be used to hold colored filters to customize the output color of any TROV fixture, except the ASYM. Color filters supplied by others.
Snap-on Lens, Frosted, 48 inch, L50.....	LENS-L50-FROST-48	
Snap-on Lens, Clear, 12 inch, L50.....	LENS-L50-CLEAR-12	
Snap-on Lens, Clear, 48 inch, L50.....	LENS-L50-CLEAR-48	

##### Wall Mount Arm

Wall Mount Arm, 6 inch, TROV.....	WMA-L-CA-06	Wall Mount Arms needed = For individual fixture installations two arms and one end set will be needed per fixture. For continuous run installation one endset will be needed per run. Each end set contains one left and one right end plate. One joining set will be needed per joint. One arm per fixture will be need plus one extra arm to complete the run. For example: A 10ft run made with two 4ft and two 1ft fixtures will contain: 1 x WMA-L-END, 3 x WMA-L-JNR, and 5 x WMA-L-CA-12. Leader cables are not included with wall mount arms, end sets, or joiners sets.
Wall Mount Arm, 12 inch, TROV.....	WMA-L-CA-12	
Wall Mount Arm, 18 inch, TROV.....	WMA-L-CA-18	
Wall Mount Arm, 24 inch, TROV.....	WMA-L-CA-24	
Wall Mount Arm End Plate Set, TROV, Includes Left and Right.....	WMA-L-END	
Wall Mount Arm Joiner Plate, TROV.....	WMA-L-JNR	

##### Louvers

Louver, Asymmetric, 12 inch, L50.....	LV-L50-ASYM-12	Louvers Needed = One 12" louver is needed per 12" fixture and one 48" louver is needed per 48" fixture. 48" louver is made up of four 12" louvers. Louvers cannot be used with the asymmetric fixture
Louver, Asymmetric, 48 inch, L50.....	LV-L50-ASYM-48	
Louver, Symmetric, 12 inch, L50.....	LV-L50-SYM-12	
Louver, Symmetric, 48 inch, L50.....	LV-L50-SYM-48	
Louver, Honeycomb, 12 inch, L50.....	LV-L50-HCOMB-12	
Louver, Honeycomb, 48 inch, L50.....	LV-L50-HCOMB-48	

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#### Notes:

Provide 20% of each type and rating installed for Attic Stock. Furnish at least one of each type.

Provide 0-10V control module LDCM-PL-120-277-0 10V-GR if required per Lighting Control panel specification

Type:

R04-A

Page 2 of 8

Notes:

ECOSENSE®

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OVERVIEW • SPECIFICATIONS • ORDERING

INTERIOR + EXTERIOR | L50 WASH

DATE	PROJECT	FIRM	TYPE
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**OPTIONAL ACCESSORIES**

**Masking Plates**

Masking Plate, 3 inch high, 12 inch, L50 & L35 ..... MP-L50-3H-12  
Masking Plate, 3 inch high, 48 inch, L50 & L35 ..... MP-L50-3H-48  
Masking Plates needed = One 12" lens is needed per 12" fixture and one 48" lens is needed per 48" fixture.

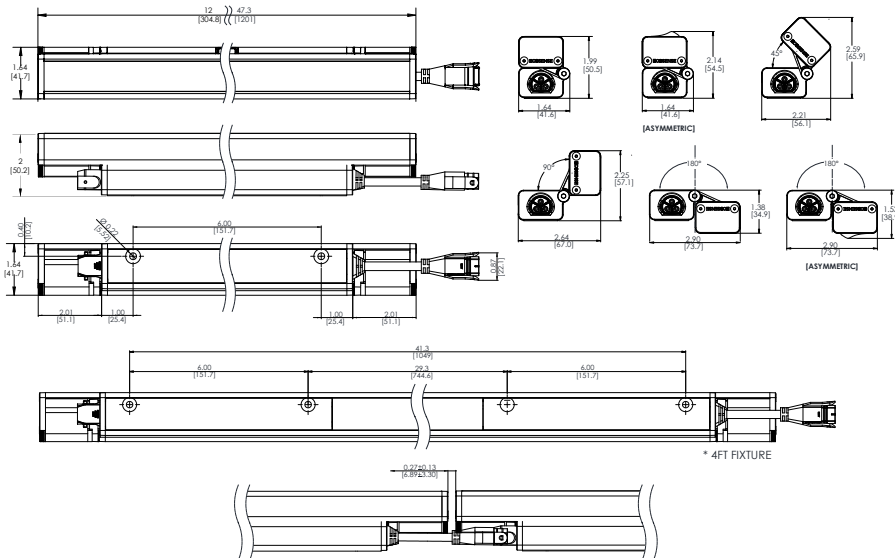
**Landscape Stake**

Landscape Stake, 6 inch, TROV, Set of 2 ..... LS-L-STK-06  
Landscape Stake, 12 inch, TROV, Set of 2 ..... LS-L-STK-12  
Landscape Stake, 18 inch, TROV, Set of 2 ..... LS-L-STK-18  
Landscape Stakes needed = 12" and 48" fixtures both need one set of 2.

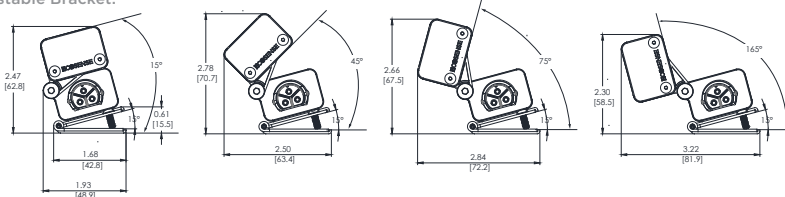
**Wire Box**

Conduit Connection, Wire Box, TROV, Interior Only, L50 ..... CC-L-WIREBOX  
Wire box can be used instead of a leader cable to start a run. 1/2" conduit fitting can attach directly to the box on one end and the fixture to the other.

**DIMENSIONS + MOUNTING**



**Fine Adjustable Bracket:**



ECOSENSE LIGHTING INC.  
837 NORTH SPRING STREET  
SUITE 103  
LOS ANGELES, CA 90012

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3/3

20190415

Type:

R04-A

Page 3 of 8

Notes:

ECOSENSE®

TRÖV

OVERVIEW • SPECIFICATIONS

ACCESSORIES | FINE ADJUSTMENT BRACKET

DATE	PROJECT	FIRM	TYPE
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TROV FINE ADJUSTMENT BRACKETS ARE IDEAL FOR APPLICATIONS THAT REQUIRE ANGLE ADJUSTMENTS SMALLER THAN 15° AND ARE HIGHLY RECOMMENDED FOR WALL GRAZING APPLICATIONS

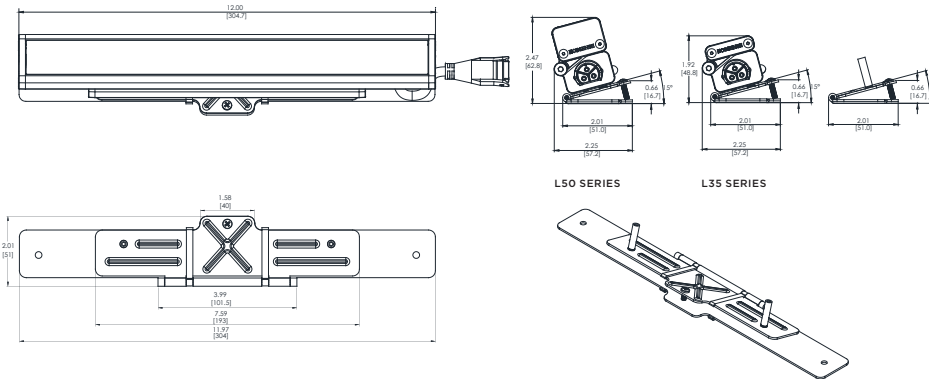
**FEATURES :**

- COMPATIBLE WITH L35 AND L50 SERIES FIXTURES
- FINE ADJUSTABLE BRACKET CAN BE SET TO ANY ANGLE FROM 1° TO 15°



<b>PHYSICAL</b>	<b>DIMENSIONS</b> <b>MATERIAL</b>	W 1.68" x H 0.61" x L 12" : (42.8mm x 15.5mm x 304.7mm) APPROX CLEAR ANODIZED ALUMINUM
-----------------	--------------------------------------	---

FINE ADJUSTMENT BRACKET for L35 AND L50



ORDERING

PART NUMBER	DESCRIPTION
MNT-L-FAB	TROV FINE ADJUSTMENT BRACKET

LIMITED WARRANTY 5 YEARS

ECOSENSE LIGHTING INC. 915 WILSHIRE BLVD SUITE 2175 LOS ANGELES, CA 90017	P • 310.496.6255 F • 310.496.6256 T • 855.632.6736 855.6.ECOSEN	SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE. VISIT <a href="http://ECOSENSELIGHTING.COM">ECOSENSELIGHTING.COM</a> FOR THE MOST CURRENT SPECIFICATIONS. © 2015 ECOSENSE LIGHTING INC. ALL RIGHTS RESERVED. ECOSENSE, THE ECOSENSE LOGO AND ECOSPEC ARE REGISTERED TRADEMARKS OF ECOSENSE LIGHTING INC.	ECOSENSELIGHTING.COM	1
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Type:

R04-A

Page 4 of 8

Notes:

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INSTALLATION GUIDE

ACCESSORIES | Fine Adjustment Bracket



EcoSense Lighting Fixtures must be installed by a qualified electrician. EcoSense Lighting, Inc. is not responsible if its fixtures are not installed in accordance with all national and local safety standards.

#### INCLUDED IN BOX

Fine Adjustment Bracket (FAB)  
Installation Guide

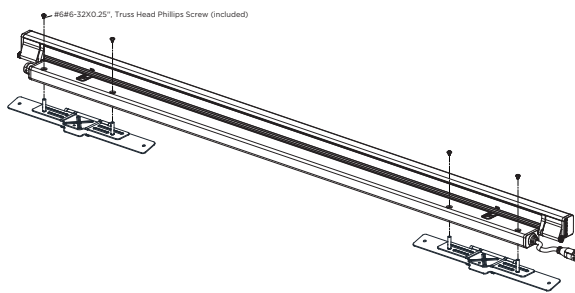
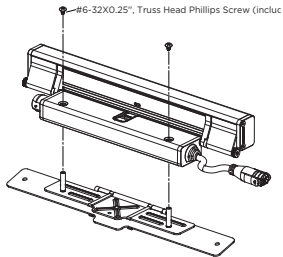
#### NOTE

• One FAB required for 1ft and two required for 4ft Fixture. FAB works the same for L35 and L50.

### INSTALL THE FIXTURES

#### Step 1: Mount Fixture to FAB(S)

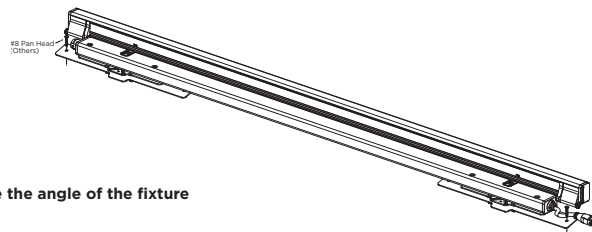
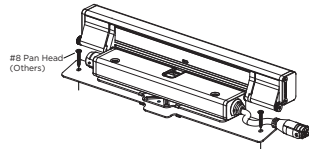
- Use the #6-32 screws (2 included per FAB)



Ensure power is OFF

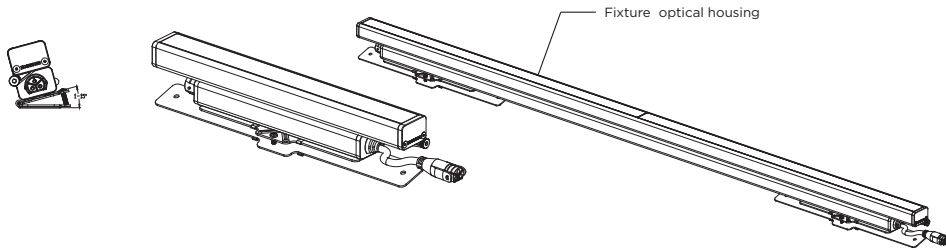
#### Step 2: Mount FAB to surface.

- Use 2 #8 screws per fixture.



#### Step 3: Turn adjustment screw to change the angle of the fixture

- Adjusts angle from 1° to 15°
- If a greater angle is required, rotate the fixture optical housing. Each 'Click' represents 15°



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1

Type:

R04-A

Page 5 of 8

# ECOSENSE<sup>®</sup>

OVERVIEW • SPECIFICATIONS • ORDERING

# ECOSPEC<sup>™</sup>

ACCESSORIES | LDCM

DATE	PROJECT	FIRM	TYPE
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ECOSPEC<sup>®</sup> LINEAR DIMMING CONTROL MODULE PLENUM RATED (LDCM-PL) TAKES A 0-10V DIMMING SIGNAL AND A FIXED LINE VOLTAGE INPUT AND CONVERTS IT TO A REVERSE PHASE DIMMED OUTPUT FOR UP TO 1000W WITH A 277V LOAD AND 450W ON A 120V LOAD. ONE LDCM CAN BE USED PER RUN UP TO THE MAXIMUM WATTAGE. THE LDCM-PL IS RATED TO DIRECTLY MOUNT TO A JUNCTION BOX IN A PLENUM SPACE FOR EASIER INSTALLATIONS AND TO MEET BUILDING REQUIREMENTS.

#### FEATURES :

- DIMS REVERSE PHASE ONLY FIXTURES WITH 0-10V
- SIMPLE INSTALLATION
- DIRECT J-BOX MOUNT
- 120V AND 277V COMPATIBLE
- AUTO-SENSING VOLTAGE SWITCH
- 450W @120V, 1000W @277V
- PLENUM RATED
- ONE LDCM PER FIXTURE RUN

FOR USE WITH ECOSENSE<sup>®</sup> PRODUCTS **ONLY**, WARRANTY ONLY VALID WHEN USED WITH ECOSENSE LIGHTING PRODUCTS. FOR MORE INFORMATION ON TESTING YOUR PRODUCT WITH THE ECOSENSE LDCM PLEASE EMAIL [INFO@ECOSENSELIGHTING.COM](mailto:INFO@ECOSENSELIGHTING.COM).



MODEL	VOLTAGE	CONTROL	COLOR
LDCM-PL	<b>120-277</b> 110VAC-120VAC, 277V Auto-Sensing Voltage Switch	<b>010V</b> - 0 - 10V	<b>GR</b> - Grey

**EXAMPLE:** LDCM-PL - 120-277 - 010V - GR

ELECTRICAL	POWER RATING	450W MAX @ 110-120V 1000W MAX @ 277V
	MAX FIXTURE RUN LENGTH	CALCULATE MAXIMUM RUN PER LDCM UNIT BASED ON THE POWER CONSUMPTION OF THE FIXTURE USED.
	OPERATING VOLTAGE	110VAC-120VAC, 277VAC - AUTO-SENSING VOLTAGE SWITCH
	OPERATING HERTZ	60 Hz
	STARTUP TEMPERATURE	-4°F TO 104°F (-20°C TO 40°C)
	OPERATING TEMPERATURE	-4°F TO 104°F (-20°C TO 40°C)
	STORAGE TEMPERATURE	-4°F TO 176°F (-40°C TO 80°C)
CONTROL	DIMMING	110-120VAC; REVERSE PHASE; CONVERTED FROM 0-10V CONTROLLER 277VAC; REVERSE PHASE; CONVERTED FROM 0-10V CONTROLLER
PHYSICAL	DIMENSIONS	W 3.4" x H 2" x L 7" ; (87mm x 50mm x 178mm)
	HOUSING / LENS	INJECTION MOLDED POLYCARBONATE
	CONNECTORS	LEAD WIRE 6" FROM CONDUIT
	WEIGHT	0.99 LBS (0.45 KG)
	ENVIRONMENT	ETL DAMP LOCATION
	MOUNTING OPTIONS:	CONDUIT MOUNTING FOR BOTH SIDES
RATING & CERTIFICATIONS	ETL/cETL DAMP LOCATIONS	
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Type:

## R04-A

Page 6 of 8

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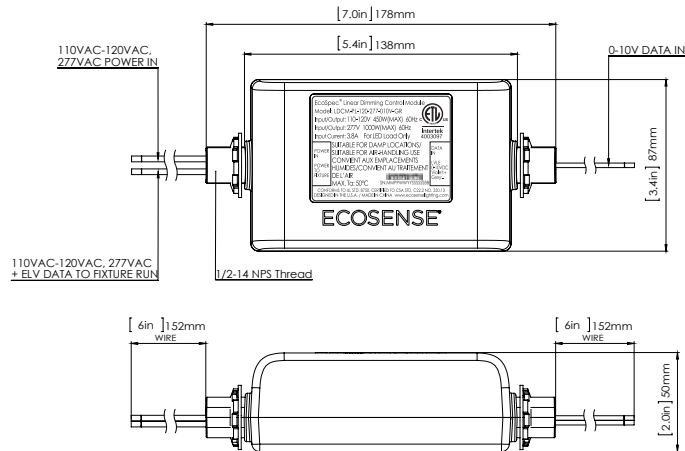
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ECOSPEC™

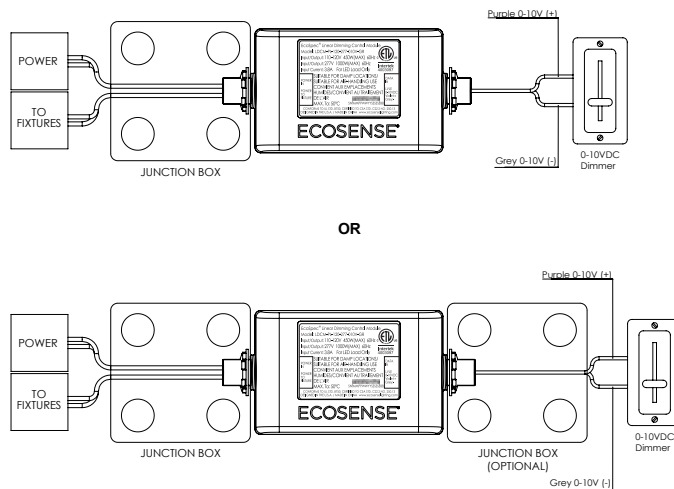
ACCESSORIES | LDCM

DATE	PROJECT	FIRM	TYPE
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DIMENSIONS



CONNECTIONS



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2/2

Notes:

Type:

R04-A

Page 7 of 8



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Notes:

Additional regressed cross-grate near wall helps reduce any over-bright areas at lower wall and provides possible place for flowers/memorial items- **by Architect**

New S.S. grate running perpendicular to granite wall. Depth of grate to be determined by cutoff needed for glare reduction - **by Architect**

Architect to confirm regressed dimension

Fine adjustment mounting bracket

Drain depth at the end of the wall

Max. drain depth

Solid section at front of grate further reduces view of fixture & glare - **by Architect**

Type R04: 9°x29° Narrow beam

Type R04-A: 40°x40° optic

Mounting profile for light fixture- **by Architect**

Trench Detail Section  
 Scale: 3" = 1'-0"

Type:

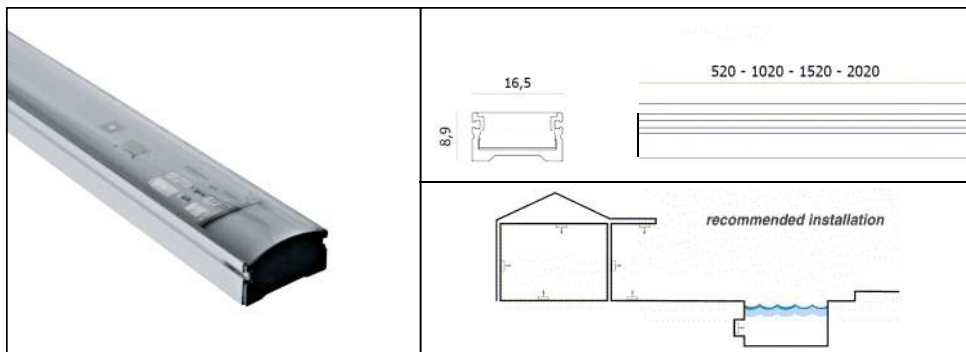
**R04-A**

Page 8 of 8





**FILO Monochromatic Power LED**  
DATA-SHEET



**PRODUCT DESCRIPTION:**

Professional linear lighting system for direct and indirect lighting suitable for indoor and outdoor settings. Body finished aluminium with transparent resin. UV resistance of all materials.

**TECHNICALS FEATURES:**

<b>Materials</b>	Aluminium extrusion alloy UNI 6060; transparent resins
<b>Finishes</b>	Anodized Aluminium
<b>Power Supply</b>	24 Vdc constant voltage
<b>Power</b>	12 W/m (pitch 100 mm) ; 24 W/m (pitch 50 mm)
<b>Light Source</b>	Power LED
<b>Pitch</b>	100 mm ; 50 mm
<b>Color Temperature</b>	2700K ; 3000K ; 4000K
<b>Ra</b>	> 80
<b>Chromatic Selection</b>	Mac-Adam 2-step
<b>Lifetime</b>	> 50000 h (TM21)
<b>Optics</b>	Transparent diffuser
<b>Tc metal body</b>	< 90 °C
<b>Ta operating temperature</b>	- 30 ÷ 50 °C
<b>Ts surface temperature</b>	≤ 65 °C
<b>Functions</b>	On/Off ; dimmable
<b>Cable</b>	AWM style 20233 2xAWG18 (Red;Black)+1xAWG20 (Violet) L. 1m.
<b>Weight</b>	250 g/m
<b>Installations</b>	Ground Wall or Ceiling surface mounted
<b>Norms</b>	60598-1 ; 60598-2 and its parts



**NOTE:**

Power supplies, control&dimming devices and fixing kits must to be orderd separately. Aldabra power supply consumption is equal to 15% of the fixture nominal power. Photometric data available at [www.aldabra.it](http://www.aldabra.it)

Specifications are subject to change without notice.  
[www.aldabra.it](http://www.aldabra.it)

p. 1/3

**Notes:**

Surface mounted LED narrow-beam submersible fixture at Flume channel niche

Fixture to be NON DIM

EC to provide Custom Stainless Steel mounting channel as required

Provide Mounting Clips as required

Provide remote power supply(s) as required. Power supply (s) to be located in a well ventilated, accessible area

Remote driver(s) to be rated for exterior use. Additional wet location enclosure box and/or buriable enclosure may be required

Notes continue on next pages....

- ☐ Standard  
☒ Modified Standard  
☐ Custom  
☐ Sample Required

Manufacturer: **ALDABRA LIGHTING**  
Catalog Number: **EK1.03-T-30-A1 + Power supply + Mounting clip + Custom Mounting channel**

Lamp: 3000K LED (Included)  
Wattage : 4W/LF  
Voltage: 120V  
Finish: Manufacturer Standard Aluminum, Architect to Confirm

Type:

**R05**

Page 1 of 7

☐ Part of Series



**FILO Monochromatic Power LED**  
DATA-SHEET

**GENERAL FEATURES:**

	power (W)	length (mm)	pitch (mm)
<b>FIL.05.XXXXX.X</b>	6	520	100
<b>FIL.06.XXXXX.X</b>	12	1020	100
<b>FIL.07.XXXXX.X</b>	18	1520	100
<b>FIL.08.XXXXX.X</b>	24	2020	100
<b>FIL.09.XXXXX.X</b>	12	520	50
<b>FIL.10.XXXXX.X</b>	24	1020	50
<b>FIL.11.XXXXX.X</b>	35	1520	50
<b>FIL.12.XXXXX.X</b>	47	2020	50

**OPTICAL FEATURES:**

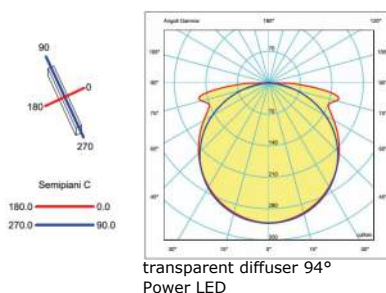
FIL.XX.TXXXX.X	Transparent diffuser 94°
----------------	--------------------------

**LED FEATURES:**

	Power LED	lm/W	lm/m	Ra	Chromatic selection
FIL.XX.X27XX.X	2700K warm white	105	1260	>80	MacAdam 2-step
FIL.XX.X30XX.X	3000K warm white	110	1320	>80	MacAdam 2-step
FIL.XX.X40XX.X	3300K warm white	130	1560	>80	MacAdam 2-step

**FINISHES FEATURES:**

FIL.XX.XXXA1.X	Anodized Aluminium
----------------	--------------------



**GENERAL INFORMATIONS:**

Kindly note that atmospheric agents ( such as lightnings, etc ) , electrostatics charges or disturbances on the installation not caused by Aldabra lighting fixtures and Led drivers indicated by Aldabra itself, may cause damages on the fixtures. It is necessary that the electrical installation where the LED lighting fittings and their power supply units and control gears are installed must be equipped with proper devices for the protection and suppression of transient phenomena (SPD, isolation transformer, etc...). Such devices must to be coordinated with the other protections of the installation; on this theme, it's necessary to refer to the electrical installations norms which are in force in each country.

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p. 2/3

10313.190507

**Notes:**

Coordinate leader cables, joiners, terminators and any additional parts as required for a complete installation

Refer to manufacturer's recommendations for maximum remote distance to minimize voltage drop

Requires manufacturer provided shop drawing(s) for approval during shop drawing coordination

Provide 20% of each type and rating installed for Attic Stock. Furnish at least one of each type.

Custom mounting channel to be provided per fixture lengths. For ease of maintenance EC to ensure fixture length and mounting bracket length is the same

Continue notes on next page...

**Type:**

**R05**

Page 2 of 7

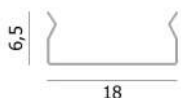


**FILO Monochromatic Power LED**  
DATA-SHEET

**ACCESSORIES:**

**ACC.0046.0**

stainless steel fixing spring - 5 pieces package



**Notes:**

Shop drawings are  
required for Custom  
mounting bracket  
approval



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p. 3/3

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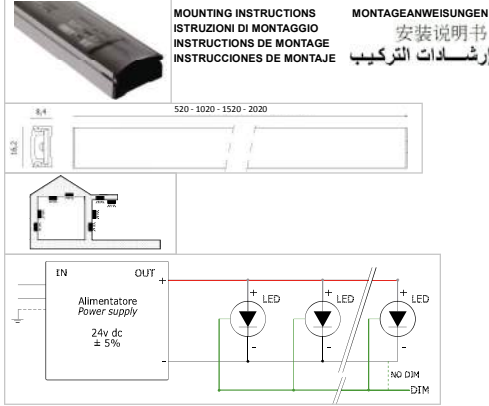
**R05**

Page 3 of 7

Notes:



FILO MONOCHROMATIC 24Vdc



- GB Important:**
- The main power must always be **TURNED OFF**, prior to installation.
  - Verify the minimum and maximum amount of LED written on the powersupply.
  - Do not test the LED individually.
  - For connection without a dimmer, connect the green wire (signal) with the black wire (negative). To be cleaned only with water and neutral soap.
  - It is the installers' responsibility to ensure that the wiring connection is IP68 rated and no humidity or water is allowed to penetrate from the wiring sleeves into the luminaire.

- I Importante:**
- I collegamenti devono essere eseguiti sempre e rigorosamente ad alimentazione **DISINSERTITA**.
  - Verificare le quantità minime e massime di LED riportati sull'alimentatore.
  - Non testare i LED singolarmente.
  - Per il collegamento senza dimmer, collegare il cavo verde (di segnale) con il cavo nero (polo negativo).
  - Pulire solo con acqua e sapone neutro.
  - E' responsabilità dell'installatore garantire che il collegamento elettrico sia IP68 e che né l'umidità né l'acqua possa penetrare nell'apparecchio attraverso la guaina del cavo.



Corso San Gottardo 14, 6830 Chiasso Switzerland - T. +41 (0)91 601 04 00 - E. aldabra@aldabra.it - www.aldabra.it - Specifications are subject to change without notice.

- F Important:**
- La connexion ne doit être effectuée que lorsque l'unité d'alimentation EST HORS TENSION.
  - Vérifier le nombre minimum et maximum de LED indiqué sur l'unité d'alimentation.
  - Ne pas tester les LED individuellement.
  - Pour la jonction sans le dimmer, relier le câble vert ( de signal) avec le câble noir (pôle négatif).
  - N'utiliser seulement avec de l'eau et du savon neutre.
  - C'est responsabilité de l'installateur garantir que la connexion électrique soit IP 68 et que ni l'humidité ni l'eau puissent entrer dans l'appareil par la gaine du câble.
- E Importante:**
- La conexión de las luminarias debe realizarse siempre con la unidad de alimentación **DESCONECTADA**.
  - Comprobar siempre el número máximo y mínimo de LED a conectar que se encuentra especificado en la unidad de alimentación. No probar los LED individualmente.
  - Para la conexión sin dimmer, conectar el cable verde (de señal) con el cable negro (polo negativo). Limpiar solo con agua y jabón neutro.
  - Es responsabilidad del instalador garantizar que la conexión eléctrica sea IP 68 y que ni la humedad ni el agua puedan penetrar en el aparato a través de la guaina del cable.
- D Wichtig:**
- Die Schaltungen sollten immer bei ausgeschalteter Stromversorgung **AUSGEFUEHRT** werden.
  - Kontrollieren Sie die minimale und die maximale LED-Anzahl, die an das Vorschaltgerät angeschlossen werden kann. Bitte LED nicht einzeln testen.
  - Wird die Leuchte ohne Dimmung eingesetzt, muss das grüne und das schwarze Kabel verbunden werden.
  - Nur mit klarem Wasser und neutraler Seife reinigen.
  - Es muss sichergestellt werden dass über die Kabel und Kabelverbindungen (IP68) kein Wasser in die Leuchte eindringen kann.
- 注意事項:**
- 安裝前必需關閉主電源。
  - 安裝前必需確認安裝器標示可使用的LED數量。
  - 安裝前必需確認安裝器在安裝時，綠色電線就接到黑色電線上。如果清洗，只可用清水和中性肥皂。
  - 安裝人員必需負責在裝置有IP68防水的接線方式時，必需百分之百防止水氣或水份穿過安裝器/接線進入裝置內。



- هام:**
- الايصال يجب دائما ان يتم عندما تكون الطاقة غير موصولة.
  - تحقق من الحد الأدنى والحد الأقصى من قيمة الـ LED المكتوبة على مجوّل الطاقة لا تختبر الـ LED بشكل فردي.
  - يجب ان يتم عمل التوصيلات حينما يكون التيار الكهربائي موصولا للتوصيل بدون خافض الاضاءة، قم بتوصيل السلك الأخضر (الإشارة) مع السلك الأسود (القطب السالب). للتنظيف استخدم الماء والصابون الخالي من الكيماويات فقط.
  - تقع المسؤولية على المرنكب في ضمان أن تكون أسلاك التوصيل من الصنف أي بي 68 والالتزام للرطوبة والماء بالنفذ من تنبئة الأسلاك إلى تركيبة الإنارة.



Type:

R05

Page 4 of 7

Notes:

**ALDABRA**  
PROFESSIONAL EXTERIOR LIGHTING  
**FILO MONOCHROMATIC 24Vdc**



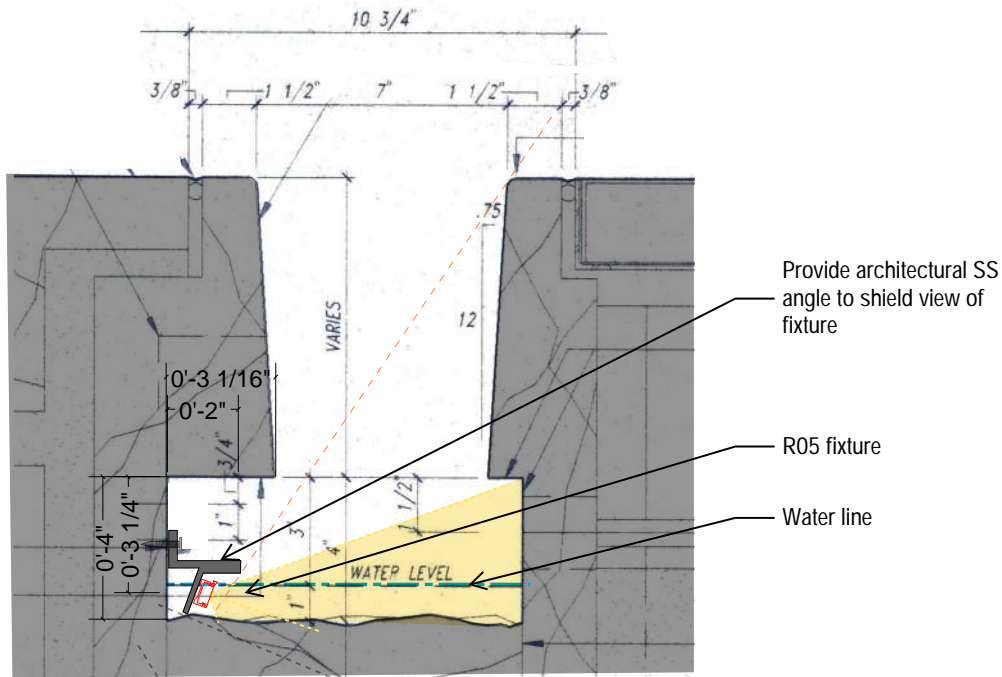
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Page 5 of 7

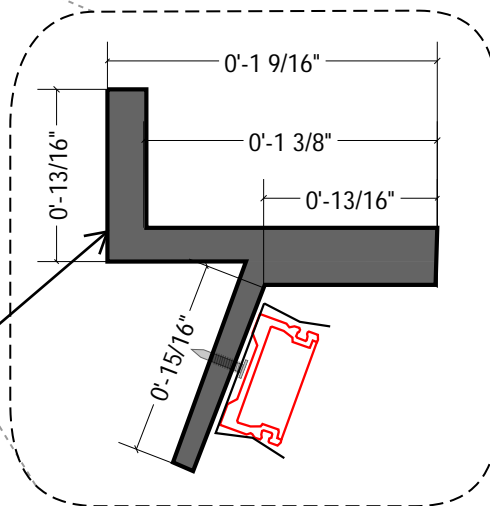
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Notes:



Flume Detail Section  
 3" = 1'-0"

Provide Custom  
 mounting channel on  
 Stainless steel or  
 Equivalent material  
 rated for Wet  
 environments



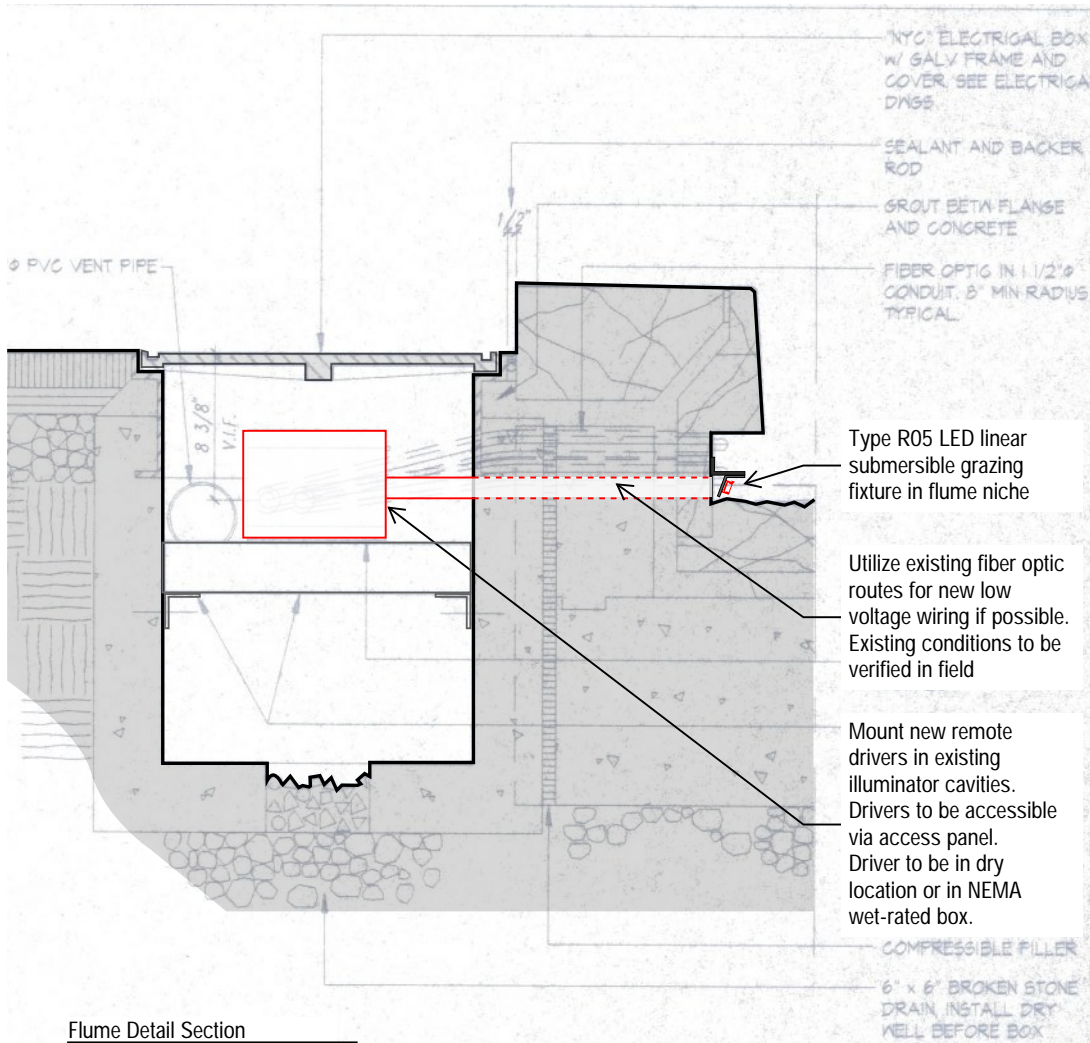
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Page 6 of 7

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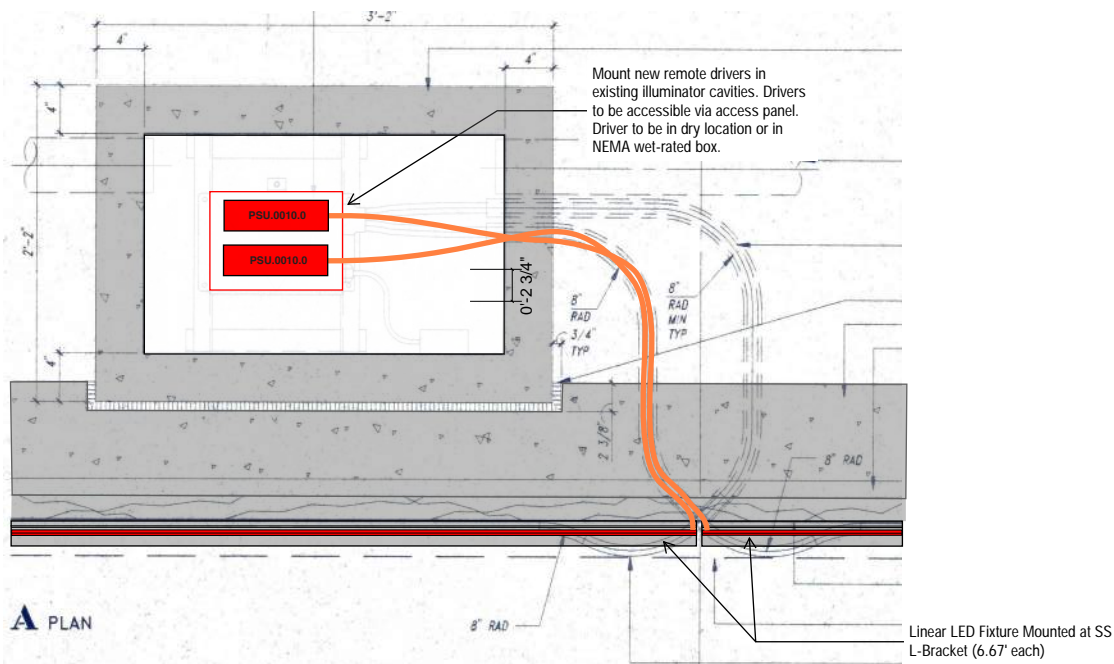
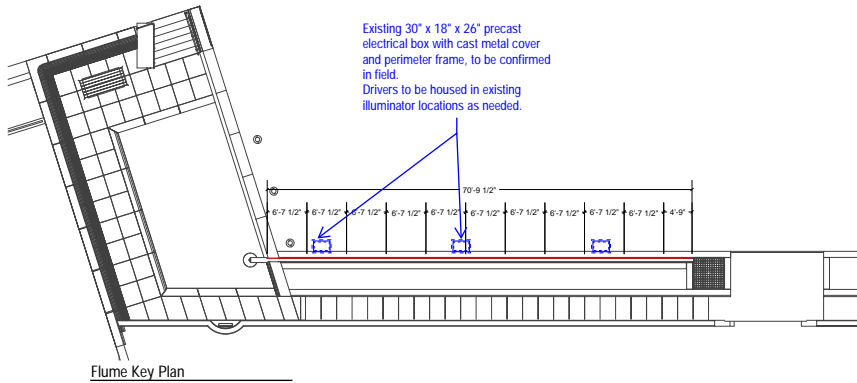
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Page 6 of 7



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Notes:



Type:

**R05**

Page 7 of 7



ECOSENSE®

TROV®

OVERVIEW • SPECIFICATIONS • ORDERING

INTERIOR + EXTERIOR | L50 GRAZE

DATE	PROJECT	FIRM	TYPE
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THE L50 INCLUDES PATENTED OPTICAL DESIGN THAT DELIVERS THE WIDEST RANGE OF BEAM ANGLE OPTIONS FOR PRECISE COVE, WALL GRAZING, WALL WASHING OR LINE OF LIGHT APPLICATIONS. EXCLUSIVE FLIP TO FLAT™ HINGE DESIGN PROVIDES FLEXIBILITY WHEN MANAGING SMALL COVE DETAILS. TROV OFFERS SMOOTH, FLICKER FREE DIMMING DOWN TO 0%.

**FEATURES :**

- DIM TO 0%, ELV REVERSE PHASE
- 24 BEAM ANGLES
- MULTI-VOLT
- FLIP TO FLAT™
- 6 CCT OPTIONS
- 80+ AND 90+ CRI OPTIONS
- IP54 INTERIOR AND IP66 EXTERIOR OPTIONS



MODEL/ SIZE	INTERIOR/ EXTERIOR	LENGTH	POWER	CCT	CRI	VOLTAGE	OPTICS
L50	I E	12" 48"	02 04 06 08 10 12	<b>WHITE CCT</b> 22 27 30 35 40 50	<b>MONO COLOR</b> GR*** BL AM RD***	80 90* Blank For Color	MULT (120-277V)  <b>GRAZING</b> 9 x 9 9 x 17 9 x 29 9 x 59 15 x 15 15 x 23 15 x 35 15 x 65 <b>COVE</b> 120** Asym <b>LINE OF LIGHT</b> LOL

**EXAMPLE:** L50-I-48-10-27-90-MULT-15x65 \*90 CRI not available in 2200K or 5000K \*\*120 is only available with Exterior option. See L35 spec sheet for interior cove options. \*\*\*Red is not available in 12W or 10W. \*\*\*Green is not available in 12W.

PERFORMANCE	WATTS	OPTIC	LUMEN OUTPUT	EFFICACY
	2W	9'x 29"	110 lm/LF ( 361 lm/m )	55 lm/W
	4W	9'x 29"	302 lm/LF ( 1037 lm/m )	76 lm/W
	6W	9'x 29"	482 lm/LF ( 1614 lm/m )	80 lm/W
	8W	9'x 29"	675 lm/LF ( 2224 lm/m )	84 lm/W
	10W	9'x 29"	785 lm/LF ( 2644 lm/m )	79 lm/W
	12W	9'x 29"	923 lm/LF ( 3109 lm/m )	77 lm/W

ALL LUMEN DATA IS FROM 4000K 80CRI FIXTURES. PLEASE SEE PHOTOMETRY SPEC SHEET FOR ADDITIONAL LUMEN DATA.

<b>COLOR RENDERING INDEX</b>	80+ 90+
<b>COLOR CONSISTENCY</b>	2-STEP MACADAM ELLIPSE
<b>LUMEN DEPRECIATION / RATED LIFE</b>	WATTS   L70 @ 25C   L70 @ 50C   L90 @ 25C   L90 @ 50C
	2W-12W   >150,000   >70,000   >50,000   >25,000

\*CALCULATIONS FOR LED FIXTURES ARE BASED ON MEASUREMENTS THAT COMPLY WITH IES LM-80 TESTING PROCEDURES AND IES TM-21 CALCULATOR

ELECTRICAL	POWER CONSUMPTION	2W/LF (6.6W/M); 4W/LF (13.2W/M) ; 6W/LF (19.8W/M); 8W/LF (26.4W/M); 10W/LF (33W/M); 12W/LF (39.6W/M) * 3W/LF (9.9W/M) at 220V -277V																																																																														
	MAX FIXTURE RUN LENGTH	<table><tr><th></th><th colspan="2">2W/LF</th><th colspan="2">4W/LF</th><th colspan="2">6W/LF</th><th colspan="2">8W/LF</th><th colspan="2">10W/LF</th><th colspan="2">12W/LF</th></tr><tr><th>Volts</th><th>Max Run all T</th><th>Max Run all 4"</th><th>Max Run all T</th><th>Max Run all 4"</th><th>Max Run all T</th><th>Max Run all 4"</th><th>Max Run all T</th><th>Max Run all 4"</th><th>Max Run all T</th><th>Max Run all 4"</th><th>Max Run all T</th><th>Max Run all 4"</th></tr><tr><td>120</td><td>214</td><td>214</td><td>186</td><td>186</td><td>152</td><td>152</td><td>114</td><td>114</td><td>91</td><td>91</td><td>76</td><td>76</td></tr><tr><td>220</td><td>374</td><td>392</td><td>340</td><td>340</td><td>277</td><td>277</td><td>209</td><td>209</td><td>95</td><td>167</td><td>95</td><td>139</td></tr><tr><td>277</td><td>374</td><td>494</td><td>374</td><td>428</td><td>349</td><td>349</td><td>263</td><td>263</td><td>95</td><td>190</td><td>95</td><td>175</td></tr></table>															2W/LF		4W/LF		6W/LF		8W/LF		10W/LF		12W/LF		Volts	Max Run all T	Max Run all 4"	Max Run all T	Max Run all 4"	Max Run all T	Max Run all 4"	Max Run all T	Max Run all 4"	Max Run all T	Max Run all 4"	Max Run all T	Max Run all 4"	120	214	214	186	186	152	152	114	114	91	91	76	76	220	374	392	340	340	277	277	209	209	95	167	95	139	277	374	494	374	428	349	349	263	263	95	190	95	175
		2W/LF		4W/LF		6W/LF		8W/LF		10W/LF		12W/LF																																																																				
	Volts	Max Run all T	Max Run all 4"	Max Run all T	Max Run all 4"	Max Run all T	Max Run all 4"	Max Run all T	Max Run all 4"	Max Run all T	Max Run all 4"	Max Run all T	Max Run all 4"																																																																			
	120	214	214	186	186	152	152	114	114	91	91	76	76																																																																			
	220	374	392	340	340	277	277	209	209	95	167	95	139																																																																			
	277	374	494	374	428	349	349	263	263	95	190	95	175																																																																			
	POWER FACTOR	4W, 6W, 8W, 10W, 12W >0.9, 2W<0.9																																																																														
	OPERATING VOLTAGE	MULTIVOLT: 110-277VAC, 50/60 Hz																																																																														
	DRIVER	INTEGRAL TO FIXTURE; DE-RATED POWER AND SYNCHRONOUS START-UP AT FULL BRIGHTNESS																																																																														
STARTUP TEMPERATURE	-40°F TO 122°F (-40°C TO 50°C)																																																																															
OPERATING TEMPERATURE	-40°F TO 122°F (-40°C TO 50°C)																																																																															
STORAGE TEMPERATURE	-40°F TO 176°F (-40°C TO 80°C)																																																																															

ECOSENSE LIGHTING INC. 837 NORTH SPRING STREET SUITE 103 LOS ANGELES, CA 90012	P • 310.496.6255 F • 310.496.6256 T • 855.632.6736 855.6.ECOSEN	SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE. VISIT ECOSENSELIGHTING.COM FOR THE MOST CURRENT SPECIFICATIONS. FOR A LIST OF PATENTS VISIT ECOSENSELIGHTING.COM/IP-PORFOLD/ ©2019 ECOSENSE LIGHTING INC. ALL RIGHTS RESERVED. ECOSENSE, THE ECOSENSE LOGO, TROV, TROV AND ECOSPEC ARE REGISTERED TRADEMARKS OF ECOSENSE LIGHTING INC. RISE™, SLIM COVE™, FREEDOM TO CREATE™, MACRO™, FLIP-TO-FLAT™ ARE TRADEMARKS OF ECOSENSE LIGHTING INC.	ECOSENSELIGHTING.COM	1/3
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**Notes:**

Surface mounted  
linear adjustable LED  
downlight at  
Dedication Plaque

Fixture to be  
NON DIM

Coordinate leader  
cables, joiners,  
terminators and any  
additional parts as  
required for a  
complete installation

Note: 12in fixtures  
require (1) set of (2)  
L-brackets each.

Replace existing  
glass lens at fixture  
location with  
laminated solite  
glass.

Provide 20% of each  
type and rating  
installed for Attic  
Stock. Furnish at  
least one of each  
type.

- ☒ Standard  
☐ Modified Standard  
☐ Custom  
☐ Sample Required

Manufacturer: ECOSENSE LIGHTING  
Catalog Number: L50-E-(12"-48")-06-30-80-MULT-15x15 + MNT-L-LBKT (AS REQUIRED)

Lamp: 3000K LED (Included)  
Wattage : 6W/LF  
Voltage: 120V  
Finish: Manufacturer Standard Aluminum, Architect to Confirm

Type:

R06

Page 1 of 4

☐ Part of Series

Notes:

ECOSENSE®

TROV®

OVERVIEW • SPECIFICATIONS • ORDERING

INTERIOR + EXTERIOR | L50 GRAZE

DATE	PROJECT	FIRM	TYPE
CONTROL	DIMMING	110-277VAC, ELV TYPE 0.07%-100%, REVERSE PHASE, TRAILING EDGE ETC control systems require 0-10V control using Ecosense LDCM. TROV will not work with ETC phase dimmers.	
PHYSICAL	DIMENSIONS	W 1.6" x H 2" x L 12"/48" : (41.6mm x 50.5mm x 304.7mm/1201mm)	
	HOUSING / LENS	EXTRUDED ALUMINUM; UV STABILIZED POLYCARBONATE; STAINLESS STEEL FASTENERS; PLASTIC ENDCAPS RUBBER OVERMOLD FOR CABLE ASSEMBLY	
	WEIGHT	1.52LBS / 0.69KG (1FT) : 4.95LBS / 2.25KG (4FT)	
	CONNECTORS	INTEGRAL MALE/ FEMALE CONNECTORS	
	ENVIRONMENT	INDOOR • ETL CERTIFIED FOR DRY/DAMP LOCATIONS IP54 OUTDOOR • ETL CERTIFIED FOR WET LOCATIONS IP66	
BEAM ANGLE	IMPACT RATED TO IK10	Not intended to be used in water features such as waterfalls, fountains, etc.	
	GRAZING, WASHING, COVE, ASYMMETRIC, LINE OF LIGHT		
	INTEGRAL MOUNTING AND ADJUSTABLE AIMING FROM 0°-180° IN 15° INCREMENTS		
FIXTURE RATING & CERTIFICATIONS	CE, ETL CERTIFIED		
	RoHS COMPLIANT		
	ENERGY STAR COMPLIANT		
	RCM CERTIFIED		
LIMITED WARRANTY	5 YEARS		
<b>WIRING OPTIONS (MVOLT): 110-277VAC</b>			
Power Cable Assembly, TROV, Leader/Jumper, 10 foot.....		CBL-3P-L-UNV-10*	
Power Cable Assembly, TROV, Leader/Jumper, 50 foot.....		CBL-3P-L-UNV-50*	
Power Cable Assembly, TROV, Jumper, 5 foot.....		CBL-3P-L-UNV-05**	
Power Cable Assembly, TROV, Jumper, 1 foot.....		CBL-3P-L-UNV-01**	
Power Cable Assembly, TROV, Adjustable Jumper, 0" to 7".....		CBL-3P-L-UNV-ADJ	
Power Cable Assembly, TROV, Male and Female terminator caps.....		CBL-3P-L-UNV-CAPS	
*Two (2) terminators are included with the 10' and 50' power cable. One Leader need per circuit/fixture run. Cables are not plenum rated.			
** If using the 5' or 1' power cable assembly as a leader to power a run one set of CBL-3P-L-UNV-CAPS will also be need per cable.			
<b>0-10V CONTROL OPTIONS</b>			
100-120VAC / 277VAC Linear Dimming Control Module 0-10V - Plenum Rated .....		LDCM-PL-120-277-010V-GR	
All products come standard with ELV dimming capabilities. 0-10V Control options required for operation at 0-10V.			
<b>OPTIONAL ACCESSORIES</b>			
<b>Mounting</b>			
Mounting Track and Clips Set, 48 Inch Track, 8 Clips.....		MNT-L-TRKCLIP-48.....48" track and clips set will work with one 48" fixture or four 12" fixtures.	
Mounting Track and Clips Set, 12 Inch Track, 2 Clips.....		MNT-L-TRKCLIP-12.....12" track will not work with 48" fixtures.	
Mounting Track Clip, TROV, Set of 2.....		MNT-L-CLIP.....Clips needed = 12" fixtures need 1 set of 2 and 48" fixture needs 2 sets of 2.	
90 Degree L bracket, TROV, Set of 2.....		MNT-L-LBKT.....L-Brackets needed = 12" fixtures need 1 set of 2 and 48" fixture needs 1 set of 2.	
Angle Locking Clip, TROV, Pack of 10.....		MNT-L-ANGLOCK.....Angle Locks needed = 12" fixtures need 1 and 48" fixtures need 2.	
(Must order separately)			
Mounting, Fine Adjustment Bracket, TROV.....		MNT-L-FAB.....Fine Adjustment Brackets needed = 12" fixtures need 1 and 48" fixtures need 2.	
*Fine Adjustment Bracket is highly recommended for Grazing Optics.			
Mounting, Fine Adjustment L-Bracket, TROV.....		MNT-L-LFAB.....Fine Adjustment L-Brackets needed = 12" fixtures need 1 and 48" fixtures need 2.	
*Fine Adjustment L-Bracket is recommended for Asymmetric Optics when aiming is needed.			
<b>Snap-on Lenses</b>			
Snap-on Lens, Frosted, 12 inch, L50 .....		LENS-L50-FROST-12	
Snap-on Lens, Frosted, 48 inch, L50 .....		LENS-L50-FROST-48	
Snap-on Lens, Clear, 12 inch, L50 .....		LENS-L50-CLEAR-12	
Snap-on Lens, Clear, 48 inch, L50 .....		LENS-L50-CLEAR-48	
Snap-on Lenses need = One 12" lens is needed per 12" fixture and one 48" lens is needed per 48" fixture. Snap on Lenses will not work with the asymmetric fixture. Clear lenses can be used to hold colored filters to customize the output color of any TROV fixture, except the ASYM. Color filters supplied by others.			
<b>Wall Mount Arm</b>			
Wall Mount Arm, 6 inch, TROV.....		WMA-L-CA-06	
Wall Mount Arm, 12 inch, TROV.....		WMA-L-CA-12	
Wall Mount Arm, 18 inch, TROV.....		WMA-L-CA-18	
Wall Mount Arm, 24 inch, TROV.....		WMA-L-CA-24	
Wall Mount Arm End Plate Set, TROV, Includes Left and Right.....		WMA-L-END	
Wall Mount Arm Joiner Plate, TROV .....		WMA-L-JNR	
Wall Mount Arms needed = For individual fixture installations two arms and one end set will be needed per fixture. For continuous run installation one endset will be needed per run. Each end set contains one left and one right end plate. One joining set will be needed per joint. One arm per fixture will be need plus one extra arm to complete the run. For example: A 10ft run made with two 4ft and two 1ft fixtures will contain; 1 x WMA-L-END, 3 x WMA-L-JNR, and 5 x WMA-L-CA-12. Leader cables are not included with wall mount arms, end sets, or joiners sets.			
<b>Louvers</b>			
Louver, Asymmetric, 12 inch, L50 .....		LV-L50-ASYM-12	
Louver, Asymmetric, 48 inch, L50 .....		LV-L50-ASYM-48	
Louver, Symmetric, 12 inch, L50 .....		LV-L50-SYM-12	
Louver, Symmetric, 48 inch, L50 .....		LV-L50-SYM-48	
Louver, Honeycomb, 12 inch, L50 .....		LV-L50-HCOMB-12	
Louver, Honeycomb, 48 inch, L50 .....		LV-L50-HCOMB-48	
Louvers Needed = One 12" louver is needed per 12" fixture and one 48" louver is needed per 48" fixture. 48" louver is made up of four 12" louvers. Louvers cannot be used with the asymmetric fixture			
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Type:

R06

Page 2 of 4

Notes:

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INTERIOR + EXTERIOR | L50 GRAZE

DATE	PROJECT	FIRM	TYPE
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**OPTIONAL ACCESSORIES**

**Masking Plates**

Masking Plate, 3 inch high, 12 inch, L50 & L35 ..... MP-L50-3H-12  
Masking Plate, 3 inch high, 48 inch, L50 & L35 ..... MP-L50-3H-48  
Masking Plates needed = One 12" lens is needed per 12" fixture and one 48" lens is needed per 48" fixture.

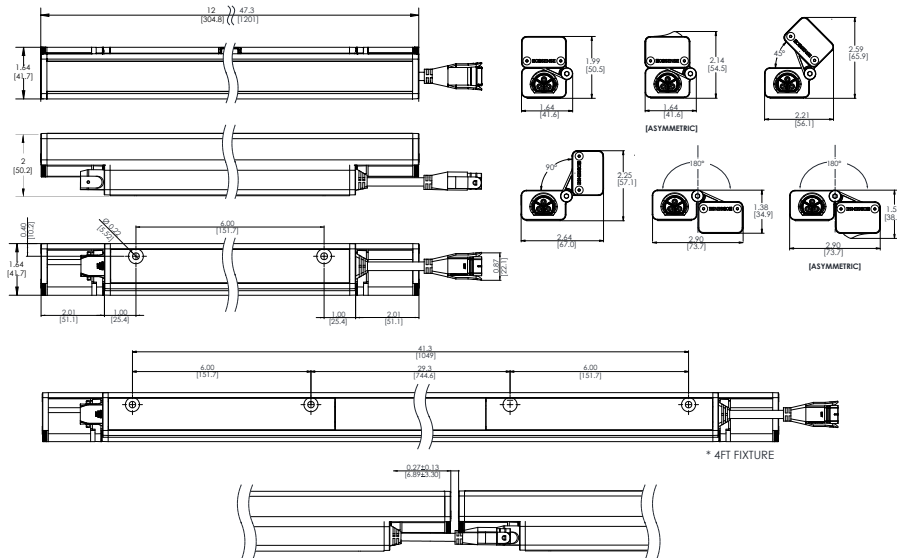
**Landscape Stake**

Landscape Stake, 6 inch, TROV, Set of 2 ..... LS-L-STK-06  
Landscape Stake, 12 inch, TROV, Set of 2 ..... LS-L-STK-12  
Landscape Stake, 18 inch, TROV, Set of 2 ..... LS-L-STK-18  
Landscape Stakes needed = 12" and 48" fixtures both need one set of 2.

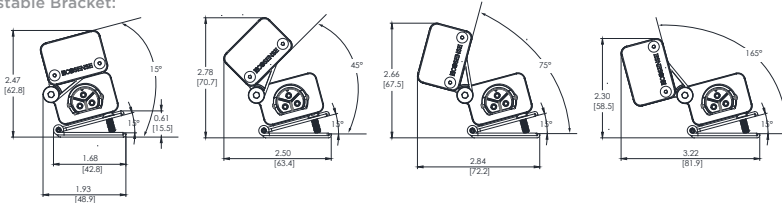
**Wire Box**

Conduit Connection, Wire Box, TROV, Interior Only, L50 ..... CC-L-WIREBOX  
Wire box can be used instead of a leader cable to start a run. 1/2" conduit fitting can attach directly to the box on one end and the fixture to the other.

**DIMENSIONS + MOUNTING**



**Fine Adjustable Bracket:**



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3/3

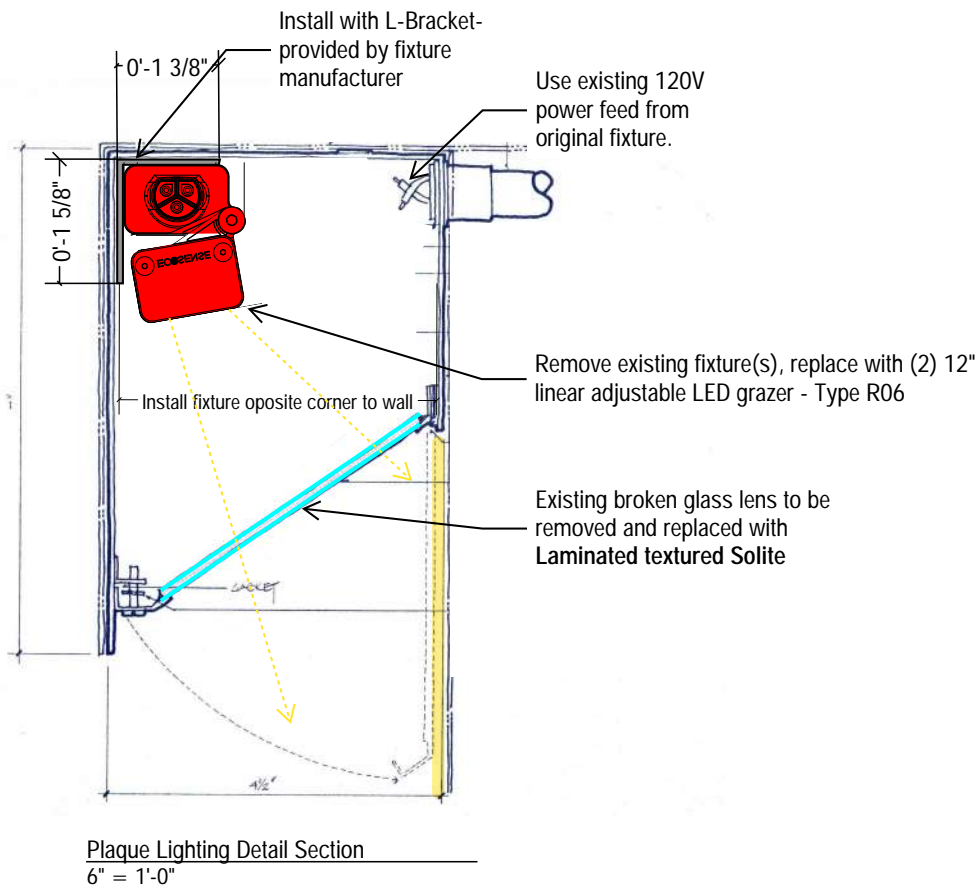
Type:

R06

Page 3 of 4

Notes:

**\*FOR DESIGN INTENT ONLY\***



Type:

**R06**

Page 4 of 4

114

ALDABRA

# VITRO



**Professional linear lighting system for direct and indirect lighting suitable for indoor, outdoor and underwater settings**

**Applications:** pools, fountains, water features, facades, steps, signs, shelves, niches

**Settings:** hotels, spa, shopping centers, private houses

**Installation:** surface mounted with adjustable brackets

**Materials:** aluminium - stainless steel - resins - polycarbonate

**Finishes:** transparent polycarbonate sleeve

**Light source:** Power LED 105 - 130 lm/W  
mid Power LED 140 - 180 lm/W

**Optics:** transparent diffuser (104°)

**Functions:** on-off, dimmable

**Features:** compact system  
double shell for watertight seal  
lengths up to 2 meters (78,74")

**Power supply:** 24 Vdc constant voltage

LED colours



Features

IP66 IP68 IK10 1562°F AQA STOP

Installation



## Notes:

Submersible LED adjustable fixtures in water cavity below Rookie fountain

Fixture to be NON DIM

Provide vandal resistant mounting bracket as required

Bottom end of fixture to be mounted approx 2'-0" below cobble support grate. (Architect to confirm)

Coordinate leader cables, joiners, terminators and any additional parts as required for a complete installation

Provide remote power supply(s) as required. Power supply (s) to be located in a well ventilated, accessible area

Notes continue on next page...

- ☒ Standard
- ☐ Modified Standard
- ☐ Custom
- ☐ Sample Required

**Manufacturer:** ALDABRA  
**Catalog Number:** VIT.09-T-30-P2-O + VRM (vandal-resistant mounting) + Power supply

**Lamp:** 3000K LED (Included)  
**Wattage :** 6W/LF  
**Voltage:** 120V  
**Finish:** Manufacturer Standard Aluminum, Architect to Confirm

**Type:**

**R07**

Page 1 of 4

☐ Part of Series

116

## VITRO



A.D.B.R.A.

Ra  
>80

32°F  
122°F

Power LED  
2-STEP  
MACROSTEP





Mid Power LED  
3-STEP  
MACROSTEP

105 - 130  
lm/W

140 - 180  
lm/W








### POWER LED 24 Vdc MONOCHROMATIC

example VIT.05.T30P2.0

				+ optics		+ LED colors		+ finishes		+ release		
pitch [in]	length [mm + in]	power [W]	code									
3,937	570 (22,44")	6	VIT.01	.T	transparent diffuser	104°	27	 warm white	2700 K	P2	 polycarbonate	.0
	1070 (42,125")	12	VIT.02									
	1570 (61,811")	17	VIT.03				30	 warm white	3000 K			
	2070 (81,496")	23	VIT.04				40	 neutral white	4000 K			
1,968	570 (22,44")	12	VIT.09									
	1070 (42,125")	24	VIT.10									
	1570 (61,811")	35	VIT.11									
	2070 (81,496")	47	VIT.12									

### MID POWER LED 24 Vdc MONOCHROMATIC

example VIT.10.T27P2.0

pitch [in]	length [mm + in]	power [W]	code	+	optics	+	LED colors	+	finishes	+	release		
0,787	570 (22,44")	4	VIT.09		.T	 transparent diffuser	104°	27	 warm white	2700 K	P2	 polycarbonate	.0
	1070 (42,125")	8	VIT.10					30	 warm white	3000 K			
	1570 (61,811")	12	VIT.11					33	 warm white	3300 K			
	2070 (81,496")	15	VIT.12					37	 neutral white	3700 K			
								52	 cool white	5200 K			

#### Page references

Accessories	page 318
Power supply units	page 328
Connection diagrams	page 334 - D1/K1

#### Notes

24 Vdc constant voltage supply dimmable, parallel connection  
LED with different color temperatures are available on request

#### Notes:

Remote driver(s) to be rated for exterior use. Additional wet location enclosure box and/or buriable enclosure may be required

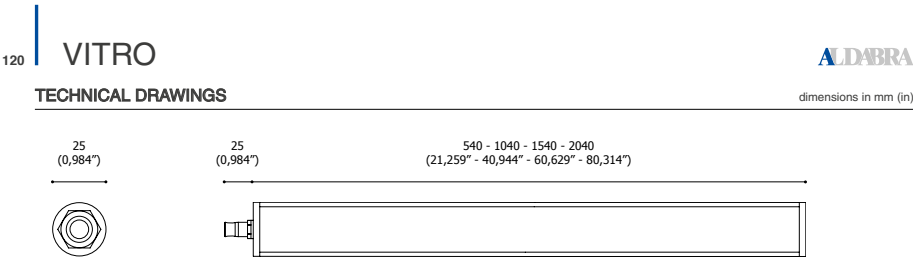
Refer to manufacturer's recommendations for maximum remote distance to minimize voltage drop

Provide 20% of each type and rating installed for Attic Stock. Furnish at least one of each type.

Type:

R07

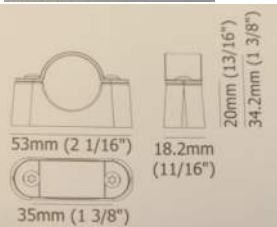
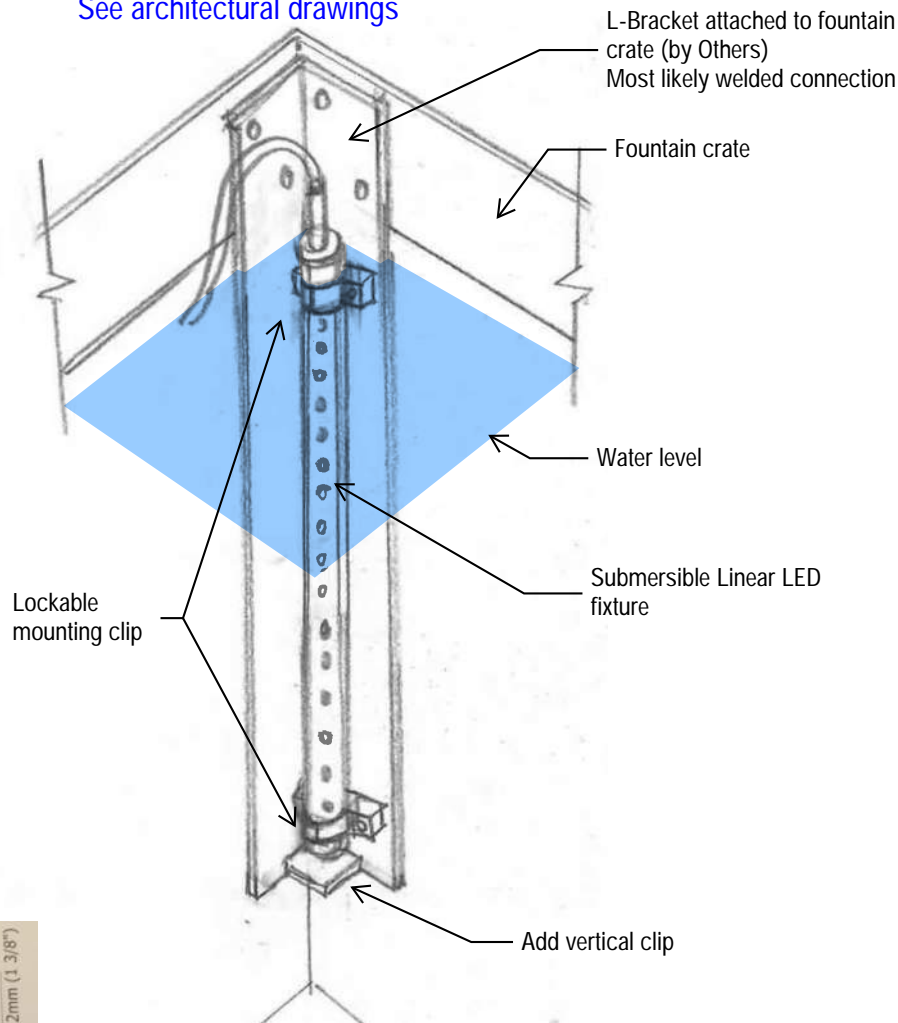
Page 2 of 4



Notes:

**\*FOR DESIGN INTENT ONLY\***

See architectural drawings



Mounting Sketch: Type R07 Submersible Linear LED fixture

Type:

**R07**

Page 4 of 4



## Function

The LED008001 Slab Hanger Compact White LED Light comes in a compact package. It is designed for situations where visibility of the light fixture needs to be de-emphasized and space near the nozzle is tight (Narrow troughs). Provides gentle lighting of lower effects.

## Specifications

Construction of fixture shall be plastic and 304/316 stainless steel.

Hardware included:

- LED emitter: 5 W / 350mA.
- Input Voltage: 12 VDC to 24VDC
- 9 ft [2.75m] or 20FT[6m] of type ST or SO submersible cable. Select when ordering.
- Clear lexan lens
- UV stabilized Delrin Top Face
- Optic: Polycarbonate 20°

1. Order your LED:

Part No.	Lamp	Color Temperature	Mounting	Application
LED008001	White	5600K (Cool)	Slab Hanger	Wet/Dry
LED008024	White	2600K (Warm)	Slab Hanger	Wet/Dry

\* For specific color temperature contact CF

2. Add one of the cables:

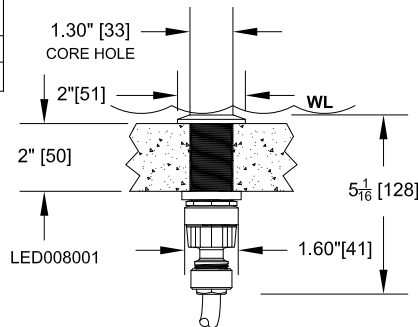
Cable	Part No.
9ft. 16/3 STW	ELCORD007LW09
20ft. 16/3 STW	ELCORD007LW20
European cable	
3m 5x1mm HO5RN-F	ELCORD007MW03
6m 5x1mm HO5RN-F	ELCORD007MW06

## Options:

1. EL PKIT10 - DMX/RDM Addressing and Play Show Tool

## Notes

1. The light is IP68 rated.
2. Fixture must be installed by a qualified electrician in accordance with all state and local codes.
3. Connect submersible cable to submersible junction boxes.
4. For wiring refer to page 2 and instruction shipped with product.
5. Contact Crystal Fountains for detailed specification, installation and operation.



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**12VDC TO 24VDC 5W MAX. Non-Dimmable  
WHITE SLAB HANGER COMPACT LED  
LIGHT**

SERIES  
LED008

REV.  
K  
SEP 2017

Due to technical progress, all designs, specifications, data sheets and components are subject to change without notice. All product information contained in this cut sheet is for information only. Please consult our web site for up to date engineering drawings. Certificates of conformance issued if required.

## Notes:

Submersible LED  
uplights at water  
feature at Rookie  
fountain

Fixture to be  
NON DIM

Provide remote  
power supply(s) as  
required. Power  
supply(s) to be  
located in a well  
ventilated, accessible  
area.

Remote driver(s) to  
be rated for exterior  
use. Additional wet  
location enclosure  
box and/or direct  
burial enclosure may  
be required.

Requires  
manufacturer  
provided shop  
drawing(s) for  
approval during shop  
drawing coordination

Notes continue on  
next page....

- ☒ Standard  
☐ Modified Standard  
☐ Custom  
☐ Sample Required

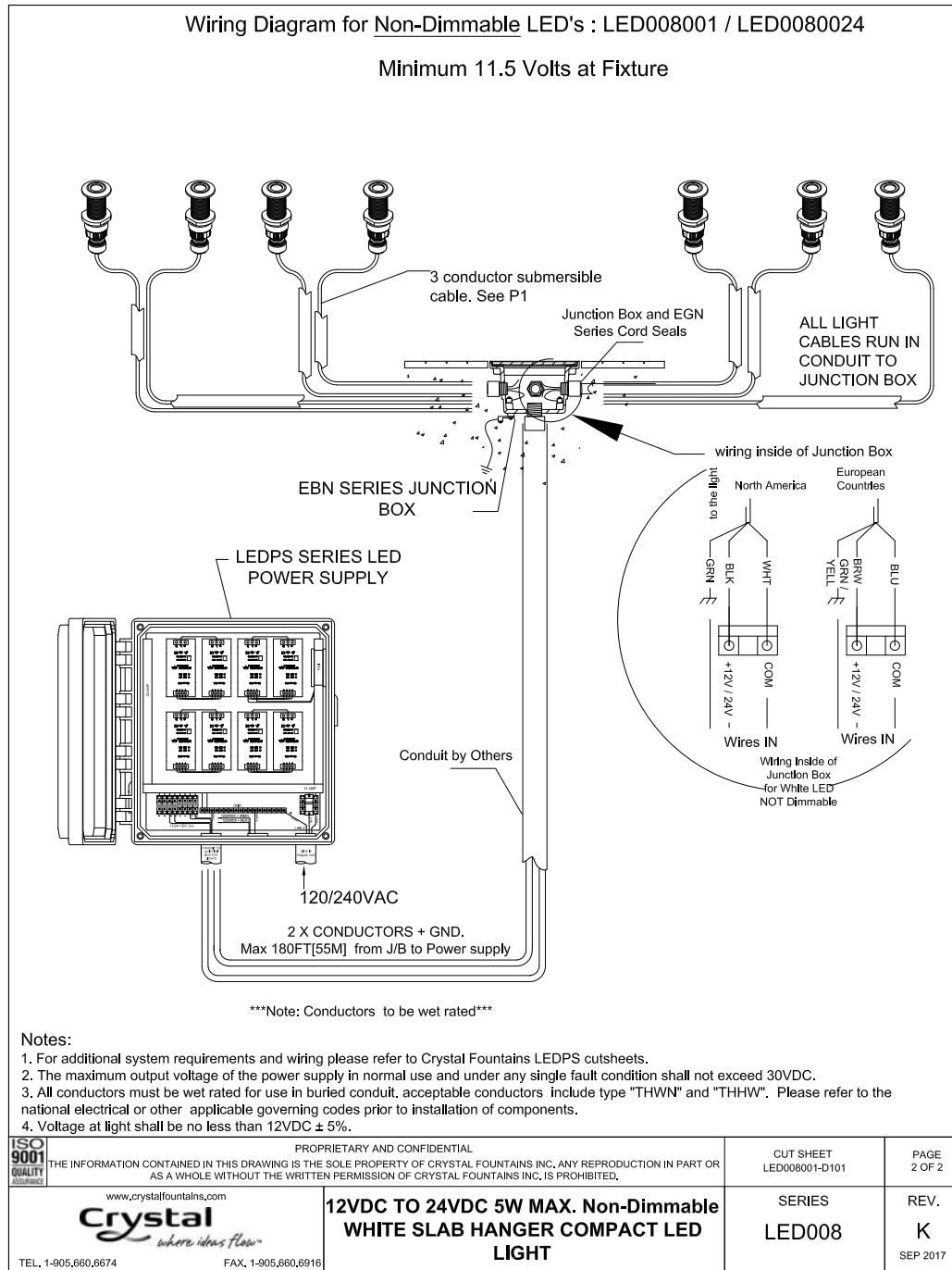
**Manufacturer:** CRYSTAL FOUNTAINS  
**Catalog Number:** LED008024 + LEDPS603-12VDC-960W + ELCORD007LW20 (AS REQ'D) + EBN208A101 (SUBMERSIBLE JBOX AS REQ'D) + EGN075 + PF1316 + EBJ C10  
**Lamp:** 2600K LED (Included)  
**Wattage :** 5W  
**Voltage:** 120V  
**Finish:** Manufacturer Standard Stainless Steel

**Type:**

**R08**

Page 1 of 7

☐ Part of Series



**Notes:**

Refer to manufacturer's recommendations for maximum remote distance to minimize voltage drop

Coordinate leader cables, joiners, terminators and any additional parts as required for a complete installation

Provide 20% of each type and rating installed for Attic Stock. Furnish at least one of each type.

Type:

**R08**

Page 2 of 7

Notes:

**Function**

Crystal Fountains LEDPS603 and LEDPS604; White Non Sequencing LED Lighting - Power Supplies are an integral component in an overall LED lighting system including (LED light + Power Supply ). The LEDPS603 (12VDC) and LEDPS604 (24VDC) power supplies are used with Crystal's non Sequencing LED Lighting .They provide 960 watts of power and can work with the following Crystal LED products:

LED008 Light Series	LED170 Light Series	LED260 Light Series
LED040 Light Series	LED180 Light Series	LED150 Dynamite Blast
LED160 Light Series	LED190 Light Series	LED165 Light Series
LED002 Light Series		

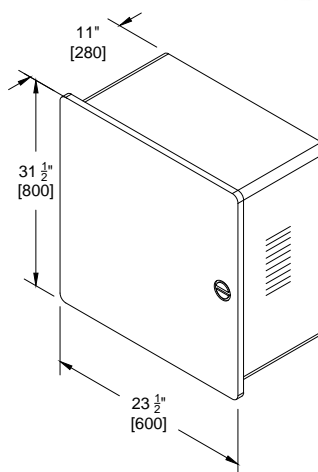
The design of the LEDPS series provides simplified wiring, ensuring system efficiency.

**Specification**

Enclosure - fiberglass or plastic box , NEMA 4  
Input voltages of 115VAC or 230VAC.  
UL508A compliance.  
Power - 960 Watts  
Operating temperature: -10°C to +40°C

**Notes**

1. Outdoor rated.
2. In coming line voltage for LEDPS is 115/230VAC, 10/5 Amp, 50-60Hz.
3. Refer to table for voltage output to LEDs.
4. refer to page 3. for internal wiring and termination diagram
5. The design of all low voltage lighting systems must include a review of voltage drop in relation to the distance of the conductor runs and the size of the conductors being run. For information on specific requirements refer to the cut sheets and installation guides of the specific product being controlled with the LEDPS series power supply
6. Contact Crystal Fountains for detailed specification, installation and operation details.
7. Fixture must be installed by a qualified electrician, in accordance with local and national codes.
8. Not all lighting solutions can be solved using the LEDPS. Please contact Crystal Fountains for custom power supply solutions.



Part No.	Output Voltage	No. of LED's powered	WHITE LED Series (30w)	No. of LED powered	WHITE LED Series (60w)	No. of LED powered	LED Series ( 5W )
LEDPS603	12VDC 80A	24	LED 160,165,170, 180, 190	12	LED260	150	LED008 LED002
LEDPS604	24VDC 40A	24	LED 165	12	LED260		

<b>ISO 9001</b> QUALITY MANAGEMENT SYSTEM CERTIFIED				PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CRYSTAL FOUNTAINS INC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CRYSTAL FOUNTAINS INC. IS PROHIBITED.		CUT SHEET LEDPS603-604-D101	PAGE 1 OF 1
www.crystalfountains.com <b>Crystal</b> <i>where ideas flow™</i> TEL: 1-905.660.6674 FAX: 1-905.660.6916		<b>12 &amp; 24VDC POWER SUPPLY LEDPS603 AND LEDPS604</b>			SERIES LEDPS	REV. C MAR 2017	

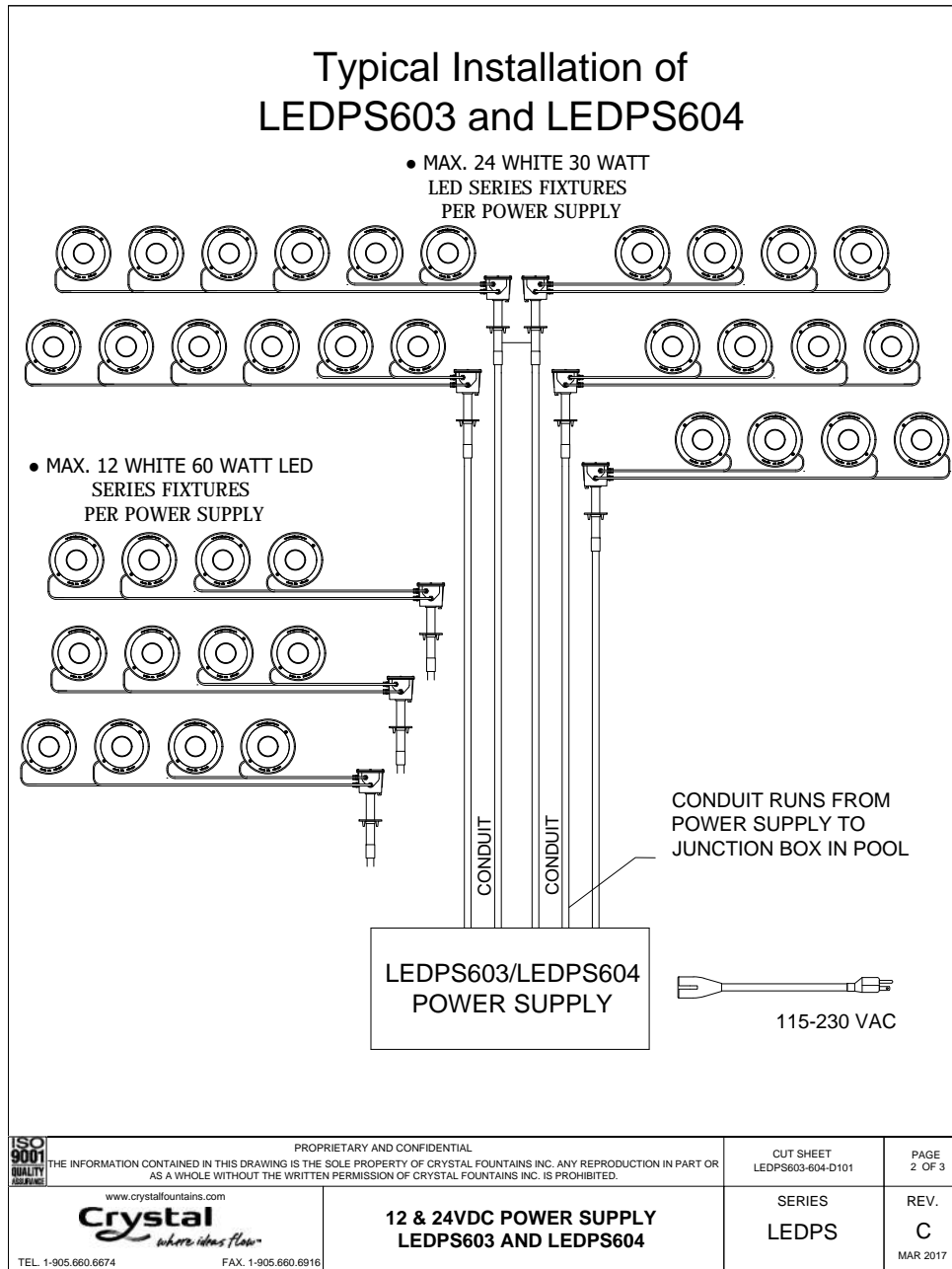
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Type:

**R08**

Page 3 of 7

Notes:

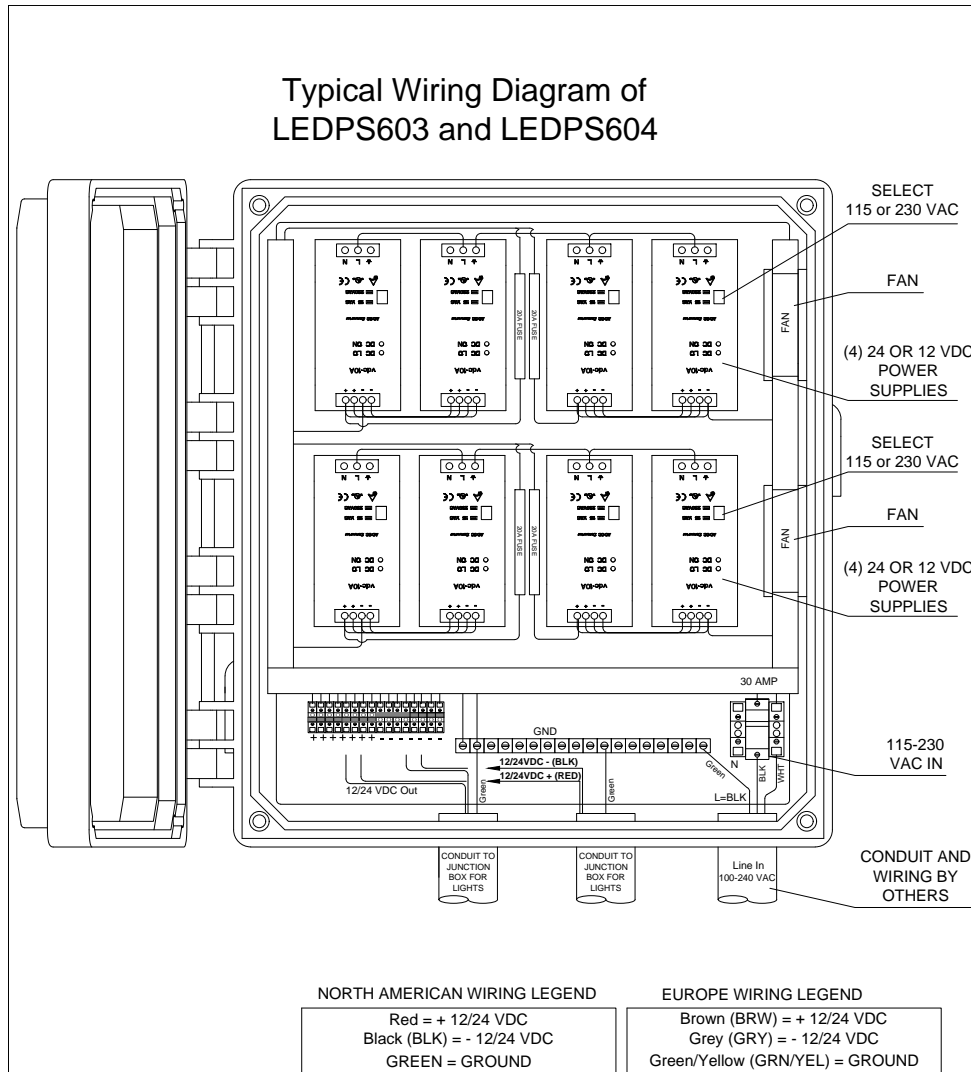


Type:

R08

Page 4 of 7

Notes:



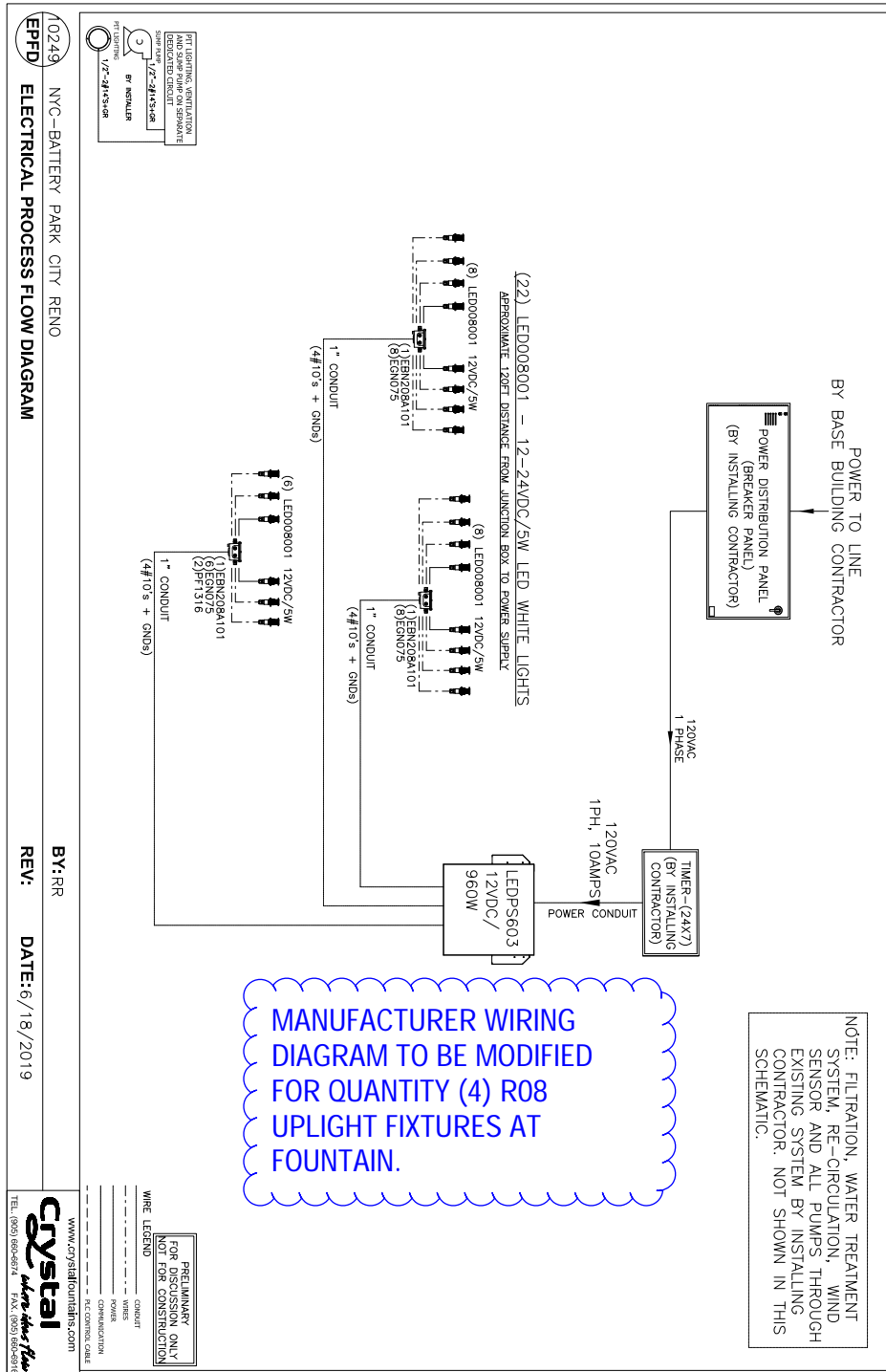
	<small>PROPRIETARY AND CONFIDENTIAL</small> <small>THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CRYSTAL FOUNTAINS INC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CRYSTAL FOUNTAINS INC. IS PROHIBITED.</small>	<small>CUT SHEET</small> <small>LEDPS603-604-D101</small>	<small>PAGE</small> <small>3 OF 3</small>
 <small>www.crystalfountains.com</small> <small>TEL. 1-905.660.6674 FAX. 1-905.660.6916</small>	<b>12 &amp; 24VDC POWER SUPPLY LEDPS603 AND LEDPS604</b>	<small>SERIES</small> <b>LEDPS</b>	<small>REV.</small> <b>C</b> <small>MAR 2017</small>

Due to technical progress, all designs, specifications, data sheets and components are subject to change without notice. All product information contained in this cut sheet is for information only. Please consult our web site for up to date engineering drawings. Certificates of conformance issued if required.

Type:

**R08**

Page 5 of 7



Notes:

Type:

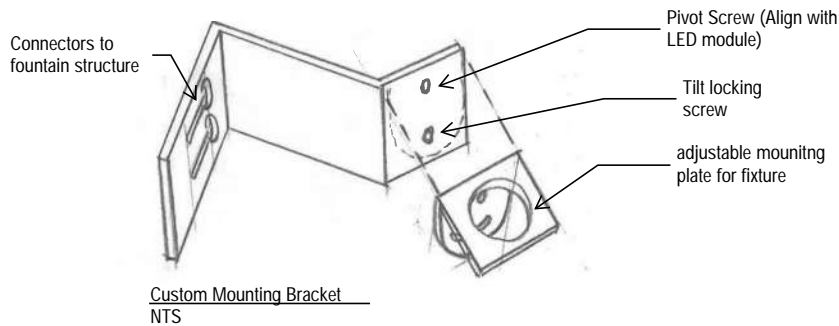
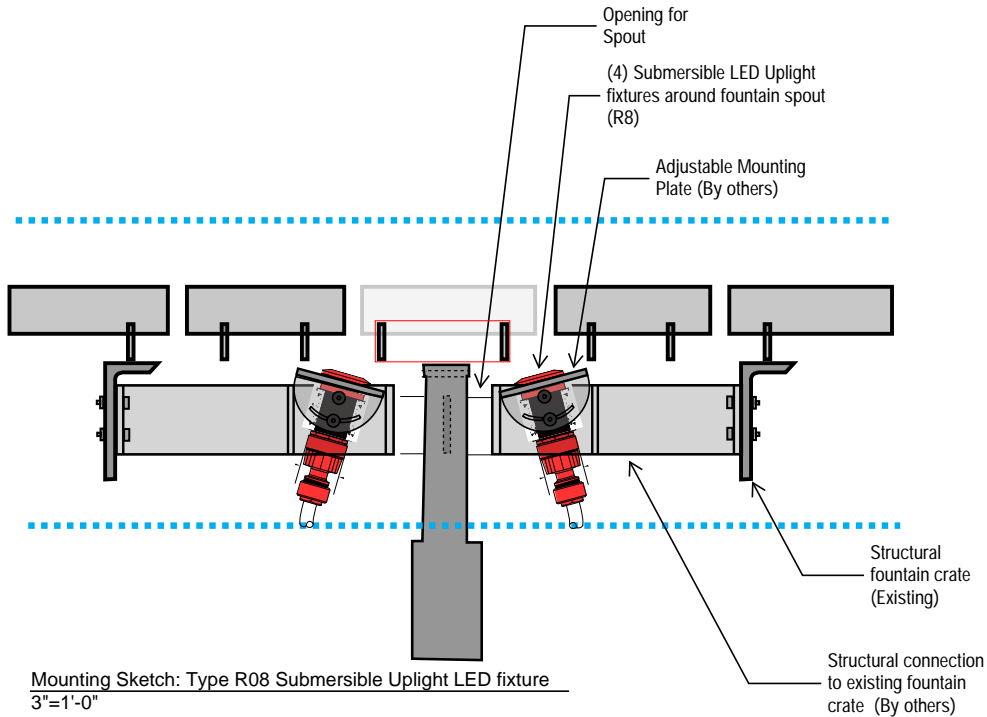
R08

Page 6 of 7

Notes:

**\*FOR DESIGN INTENT ONLY\***

See architect's drawings



Type:

**R08**

Page 7 of 7

**UPLIGHTS & PATHLIGHTS**

# MAL 10

design: Lapo Grassellini

**Supply current**  
Courant d'alimentation  
Corriente de alimentación  
**500 mA (V<sub>I</sub> 18V)**

**Power**  
Puissance  
Potencia  
**10 W**

**Series wiring**  
Câblage en série  
Cableado en serie

**Photometric diagrams**  
F975  
WALL WASHER

**CCT/CRI/Flux**  
CRI Typ. 98 / R9>90

CCT	Flux (lm)
2700K	860
3000K	912
3500K	949
4000K	985
Dim Warm	TBD

**Code Construction**  
Construction du code produit  
Construcción del código de producto

**MA1.XX.X.X**

**Finishing**  
Finitions  
Acabados

Finishing	Grey	Black	COR-TEN	INOX
	Gris	Noir	Negro	INOX AISI 316L
				Steel
				Acier
				Acero

**CRI**  
CRI Typ. 98 / R9>90

**Color Temperature**  
Température couleur  
Temperatura de color

Color Temperature	27	30	35	40	DW
	2700K	3000K	3500K	4000K	Dim Warm

**Note:** cable cut to measure on request  
**Note:** câble sur mesure disponible sur demande  
**Nota:** cable a medida disponible a petición

**Optionals**  
Accessoires  
Accesorios

**CSDS20**  
Recessing box  
Boîtier d'encastrement  
Caja de empotrar

**Drivers**  
Alimentateurs - Alimentadores

**FLEXA-60-PRO-CC-10V**  
Programmable CC  
0-10V Dimming

**ELV Dimming**

**FLEXA-26-500-CC-ELV**  
26W 500mA

**FLEXA-12-500-CC-ELV**  
12W 500mA

## Notes:

Recessed LED  
asymmetric uplights  
at North entry wall

Fixture to be  
NON DIM

MOD for Half Lens  
Shield.

Sample required for  
RDG to review prior  
to fixture order.

Asphalt pavers to be  
cut to surround  
fixture - to be  
coordinated with  
Architect.

Coordinate leader  
cables, joiners,  
terminators and any  
additional parts as  
required for a  
complete installation

Provide remote  
power supply(s) as  
required. Power  
supply (s) to be  
located in a well  
ventilated, accessible  
area

Notes continue on  
next page...

- ☐ Standard  
☒ Modified Standard  
☐ Custom  
☐ Sample Required

**Manufacturer:** ALDABRA  
**Catalog Number:** MA1-Z-9-30 + CSDSD-MOD for half lens shield + FLEXA-60-PRO-CC-10V (AS REQ'D)

**Lamp:** 3000K LED (Included)  
**Wattage :** 10W  
**Voltage:** 120V  
**Finish:** Manufacturer Standard Aluminum, Architect to Confirm

**Type:**

**R09**

Page 1 of 3

☐ Part of Series



FLEXALIGHTING  
NORTH AMERICA

## CCPRO-10V

Programmable Constant Current Driver, 0-10V, Dimmable 0.1%



High efficiency, smooth flicker-free dimming and Dim to Off capability.

The Flexa CCPRO-10V driver has a wide operating window, excellent dimming performance and programming options providing the user with a high level of flexibility.

Haute efficacité, gradation douce sans scintillement et possibilité d'atténuation de l'effet.

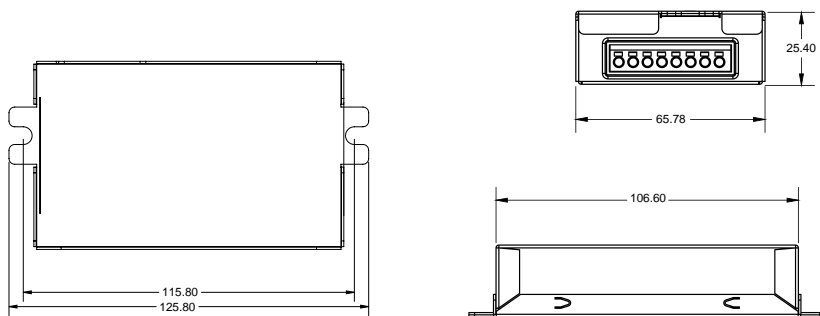
Le pilote Flexa CCPRO-10V présente une large fenêtre d'opération, d'excellentes performances de gradation et des options de programmation offrant à l'utilisateur un haut niveau de flexibilité.

Alta eficiencia, atenuación suave sin parpadeo y capacidad de atenuación / desactivación.

El controlador Flexa CCPRO-10V tiene una amplia ventana de operación, excelente rendimiento de atenuación y opciones de programación que le brindan al usuario un alto nivel de flexibilidad.

Input Voltage	Max Output Power	Output Voltage	Output Current	Efficiency @ Max Load	THD @ Max. Load	Power Factor @ Max. Load	Envir. Protection Rating	Weight
120-277VAC / VDC +/-10%	60W	3-57VDC	100-1400mA	> 90%	< 20%	> 0.95	IP21	166gr / 5.85oz

Dimensions - Dimensioni - Größe - Dimensiones

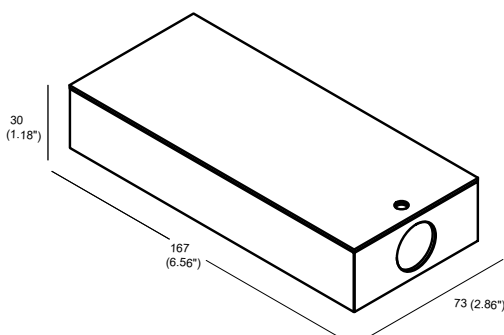


Wiring Diagram - Schéma de câblage - Diagrama de cableado

Optional BX Enclosure with 7/8" Knockouts, cULus Listed

Output		Input	
Gray	—	12V ALX (Optional)	N White
Yellow	+	120-277 VAC 50\60Hz	~ Black
Orange			⊕ Green
Orange			
Purple	+		
Gray	—		
Red	+		
Blue	—		

Input/Output/Dimming Connectors type  
Wago 253, dual side / 16-20AWG strip 3/8"



FLEXALIGHTING NORTH AMERICA

#22 - 15531 24th Avenue, Surrey, BC V4K 2J4 Canada

ph. +1 604-385-4311

info@flexalighting-na.com

### Notes:

Remote driver(s) to be rated for exterior use. Additional wet location enclosure box and/or buriable enclosure may be required

Refer to manufacturer's recommendations for maximum remote distance to minimize voltage drop

Architect to confirm Finish

Provide 20% of each type and rating installed for Attic Stock. Furnish at least one of each type.

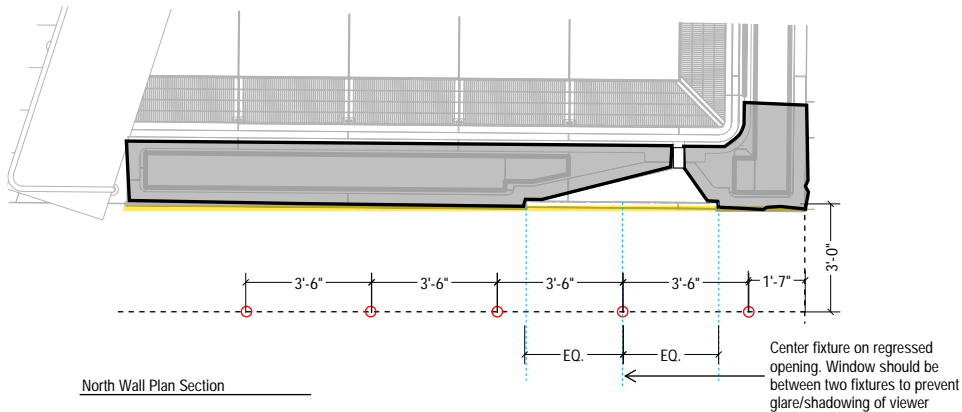
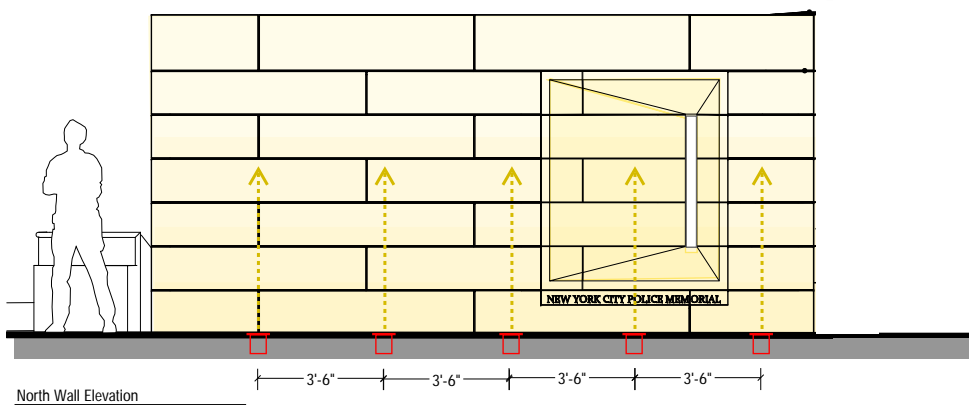
Type:

R09

Page 2 of 3

**\*FOR DESIGN INTENT ONLY\***

Notes:



Type:

**R09**

Page 3 of 3



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Brookfield, WI 53045 | FX: 262.753.6582 | sales@klikusa.com

Project Name:	Location:
Specifier:	Rep Agency:
Fixture Type:	Product Code:

## KLIIK LEDpod™ 40 Patented

### Description

Discrete, seamless point source LED fixture for use in all code-compliant handrail, especially curving ramps and helical stairs as well as long runs on bridges and pedestrian paths. Asymmetric optic allows mounting at rail nadir, eliminating uncomfortable glare issues.

### Housing

Clear anodized aluminum body as standard. Color-match anodized or bronze body as options, consult factory.

Aluminum body has a fine 25-micron finish and is then hard-coat anodized, thus preventing galvanic corrosion. Silicone gasket seals the installation from water ingress and provides added means of electrical isolation to minimize potential for galvanic reaction.

### Mounting

Patented attachment method offers unparalleled security and ease of mounting. Requires only a simple drilled hole in railing material, eliminates threading, gluing or exposed fasteners common among other handrail fixtures. All conductors remain internal to railing to provide secure and safe wiring. IK10 Impact rating ensures vandal resistance. Tamperproof anti-theft option available for extreme environments; consult factory.

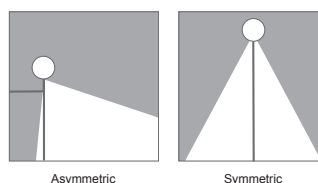
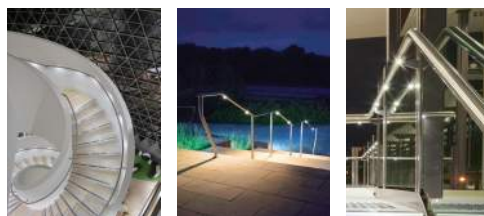
- Tube Size: Ø 1.5" - 1.75", Max. wall .2" Other sizes available upon request
- Cut Out: 25mm
- Weight: 0.16 LBS

### Electrical/LED Driver

- Input Voltage: 24 VDC
- Operating Temp: -40 to 120° F
- Efficiency: 88 lm/W
- Driver: Must use class 2 driver
  - Primary Driver: 110 - 277 VAC UL Listed Constant Voltage
  - Secondary Driver: 350 - 500mA Constant Current (provided with fixture)
- Control: DALI, 0-10V, DMX
  - DMX control for dimming only, not for individually addressed LEDpod
- Enclosure: Minimum NEMA 3R required
- Wire connectors provided; factory pre-wire available, consult factory

### Listings

- ETL listed, UL 1598/CSA 22.2; CE
- cETL
- IP65 rated All IP rated luminaires tested to AS60529-2004 Degrees of protection provided by enclosures (IP Code)
- IK10 Impact Resistance
- Wet location rated



### Product Codes

Follow the steps to specify your fixture. Enter Product Code in field at top of page. Example: LP4030KA40DIM

Fixture Type	Rail Size <sup>1,2</sup>	Color <sup>3</sup>	Distribution	Rail Wall Thickness <sup>4</sup>	Dimming <sup>5</sup>	Lens Option
LP LEDpod	40 1.50" Tube -or- 1.66" Pipe	27K 2700K 30K 3000K 35K 3500K 40K 4000K AMB Amber	A Asymmetric S Symmetric	1512 1.5" x 11ga Tube (.12 wall) 1513 1.5" x 1/8 Wall Tube 05 Sch 5 Pipe 10 Sch 10 Pipe 40 Sch 40 Pipe 80 Sch 80 Pipe CUST Non-stock	DIM Dimmable Note: 1.5 Watt is non-dimmable	Clear lens standard Add FRS for frosted diffused lens Add OTK for Optek-film diffused lens

1. Additional sizes are available as special order, contact factory for rail dimensions other than those shown on this sheet.
2. Bronze material requires a special clip, contact factory for more information.
3. Also available in blue (BLU), green (GRN), red (RED), and custom color temperature (as special order).
4. Wall thickness of 0.120" is common to steel & stainless; wall of 0.125" common to aluminum
5. Additional charges and lead time apply for this feature.
6. Tamper proof option offers additional protection in extreme environments. Additional charges and lead time apply for this feature. To specify, add "TP" to product code.
7. To Specify 1.5 Watt: add "0350" to product code.

R6.0 20190327 | KLIIK LEDpod™ 40 | Page 1 of 5

### Notes:

Handrail integrated  
low glare LED  
asymmetric  
downlights

Fixture to be  
NON DIM

Coordinate leader  
cables, joiners,  
terminators and any  
additional parts as  
required for a  
complete installation

Architect to confirm  
Handrail thickness

Provide remote  
power supply(s) as  
required. Power  
supply(s) to be  
located in a well  
ventilated, accessible  
area.

Remote driver(s) to  
be rated for exterior  
use. Additional wet  
location enclosure  
box and/or direct  
burial enclosure may  
be required.

Notes continue on  
next page..

- ☐ Standard
- ☒ Modified Standard
- ☐ Custom
- ☐ Sample Required

Manufacturer: KLIIK  
Catalog Number: LP-40-30K-A-(Rail thickness)-NON DIM + LP100WPRITRND

Lamp: 3000K LED (Included)  
Wattage : 1.5W  
Voltage: 120V  
Finish: Manufacturer Standard Aluminum, Architect to Confirm

Type:

R10

Page 1 of 6

☐ Part of Series



2840 N Brookfield Rd, Suite 3  
Brookfield, WI 53045

PH: 262.505.5124  
FX: 262.753.6582

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sales@klikusa.com

Project Name:	Location:
Specifier:	Rep Agency:
Fixture Type:	Product Code:

#### LED Performance

LED: Cree XT-E  
CCT: 2700, 3000, 4000 (others available)  
CRI: 80-85  
Life: 80% at 50k hrs and 85° C  
Binning: 3 MacAdam Steps  
Warranty: 5 Year Warranty

#### Lumens/Fixture or Pod

STANDARD	SPECIAL ORDER
2W/POD Transparent	1.5W/POD Transparent*
3000K 145	3000K 107
4000K 154	4000K 114
5000K 176	5000K 130

\*Contact factory for 1.5W POD

Optics				Reflector	
Beam Angle				Symmetrical	Asymmetrical
LOR defined by optics				76	74
lm	W	mA	V	System Lumens @4000K	
120	1.4	350	3	92	89
162	1.9	500	3	124	120

#### Remote Mounting Distance Chart

24 VDC 100W Driver	Approximate Distance From Driver to First LED at 37 Fixtures			
Wire Size	10 AWG	12 AWG	14 AWG	16 AWG
Distance	525'	328'	213'	131'

Calculations based on 2' centers between pods.  
Increased spacing reduces number of pods per circuit.

#### Primary Driver

Primary Driver	Secondary LED Driver	Spacing	Maximum KLIIK LEDpods™**
110 - 277 Primary Voltage Remotely Mounted Dimming Control 10" x 1.5" x 2"	500mA	24"	37
	350mA	24"	50

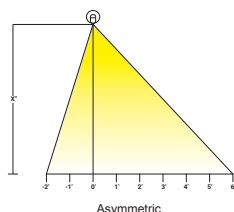
\*Based on 16 AWG between LEDpods

#### Accessories

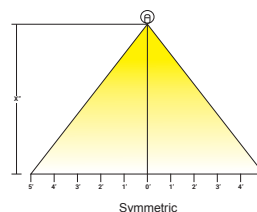
LP100WPRITRNOND Class 2 Driver, Non-Dimming, Input voltage = 120-277 VAC, Output voltage = 24 VDC, 5 year warranty Used for non-dimming KLIIK LEDpods  
LP100WPRITRNDIM Class 2 Driver, Dimming, Input voltage = 120-277 VAC, Output voltage = 24 VDC, 5 year warranty Used for dimming KLIIK LEDpods  
LPNEMA3RENCL NEMA 3R Drip Proof Enclosure, 4" x 4" x 18" (IP32 Equivalent)  
LPNEMA4ENCL NEMA 4 Watertight Enclosure, 14" x 8" x 6" (IP66 Equivalent)  
LPNEMA6PENCL NEMA 6P Submersible Enclosure 15" x 8" x 6" (IP67 Equivalent)

Additional driver & enclosure configurations available

#### KLIIK LEDpod™ Footcandle Chart



X = Rail Height (34" Tall Handrail or 42" Tall Guardrail)  
Optic Height: 34" - 1.57" (Handrail Diameter) = 32.43" (2.7')  
42" - 1.57" (Handrail Diameter) = 40.43" (3.37')



		2'	1'	0	1'	2'	3'	4'	5'	6'	7'	
1.5 Watt	KLIIK LEDpod™ 40 350mA Asymmetric	34" Tall Handrail	0.39	0.96	4.09	5.09	3.63	2.64	1.27	0.58	0.24	0.08
		42" Tall Handrail	0.36	0.86	2.63	3.29	2.73	2.03	1.47	0.81	0.43	0.22
	KLIIK LEDpod™ 40 350mA Symmetric	34" Tall Handrail	2.74	5.22	6.00	5.22	2.74	0.91	0.15	0.05	0.02	0.01
		42" Tall Handrail	2.16	3.62	3.85	3.62	2.16	1.35	0.38	0.10	0.04	0.02
2 Watt	KLIIK LEDpod™ 40 500mA Asymmetric	34" Tall Handrail	0.53	1.29	5.53	6.87	4.90	3.57	1.72	0.78	0.33	0.11
		42" Tall Handrail	0.48	1.17	3.55	4.44	3.68	2.75	1.98	1.10	0.58	0.30
	KLIIK LEDpod™ 40 500mA Symmetric	34" Tall Handrail	3.70	7.05	8.11	7.05	3.70	1.23	0.20	0.07	0.03	0.01
		42" Tall Handrail	2.92	4.90	5.20	4.90	2.92	1.83	0.52	0.13	0.05	0.02

R6.0 20190327 | KLIIK LEDpod™ 40 | Page 2 of 5

#### Notes:

Refer to manufacturer's recommendations for maximum remote distance to minimize voltage drop

Provide 20% of each type and rating installed for Attic Stock. Furnish at least one of each type.

#### Type:

**R10**

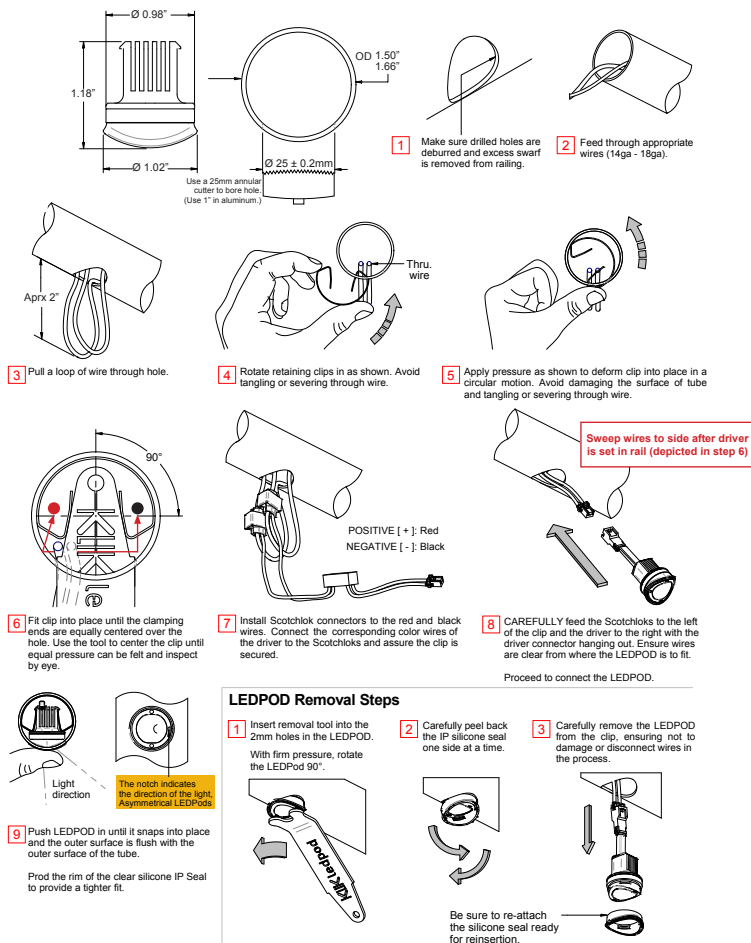
Page 2 of 6



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Project Name:	Location:
Specifier:	Rep Agency:
Fixture Type:	Product Code:

**Installation Instructions** Additional instructions may apply, consult factory.



32863-C-4

R6.0 20190327 | KLIK LEDpod™ 40 | Page 3 of 5

Notes:

Type:

R10

Page 3 of 6



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FX: 262.753.6582

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Project Name:

Location:

Specifier:

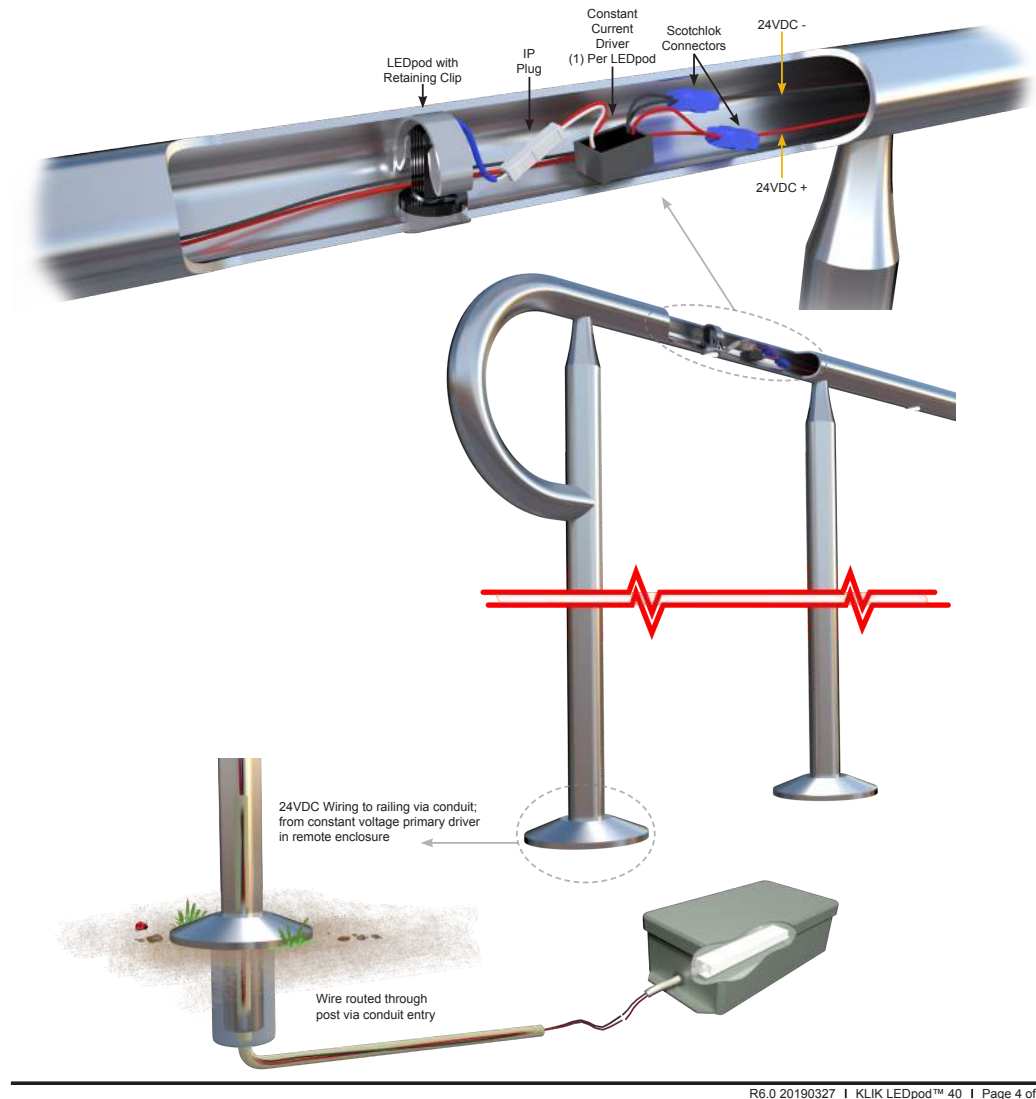
Rep Agency:

Fixture Type:

Product Code:

Notes:

**Wiring Diagram - Post Mounted**



R6.0 20190327 | KLIK LEDpod™ 40 | Page 4 of 5

Type:

**R10**

Page 4 of 6



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Project Name:

Location:

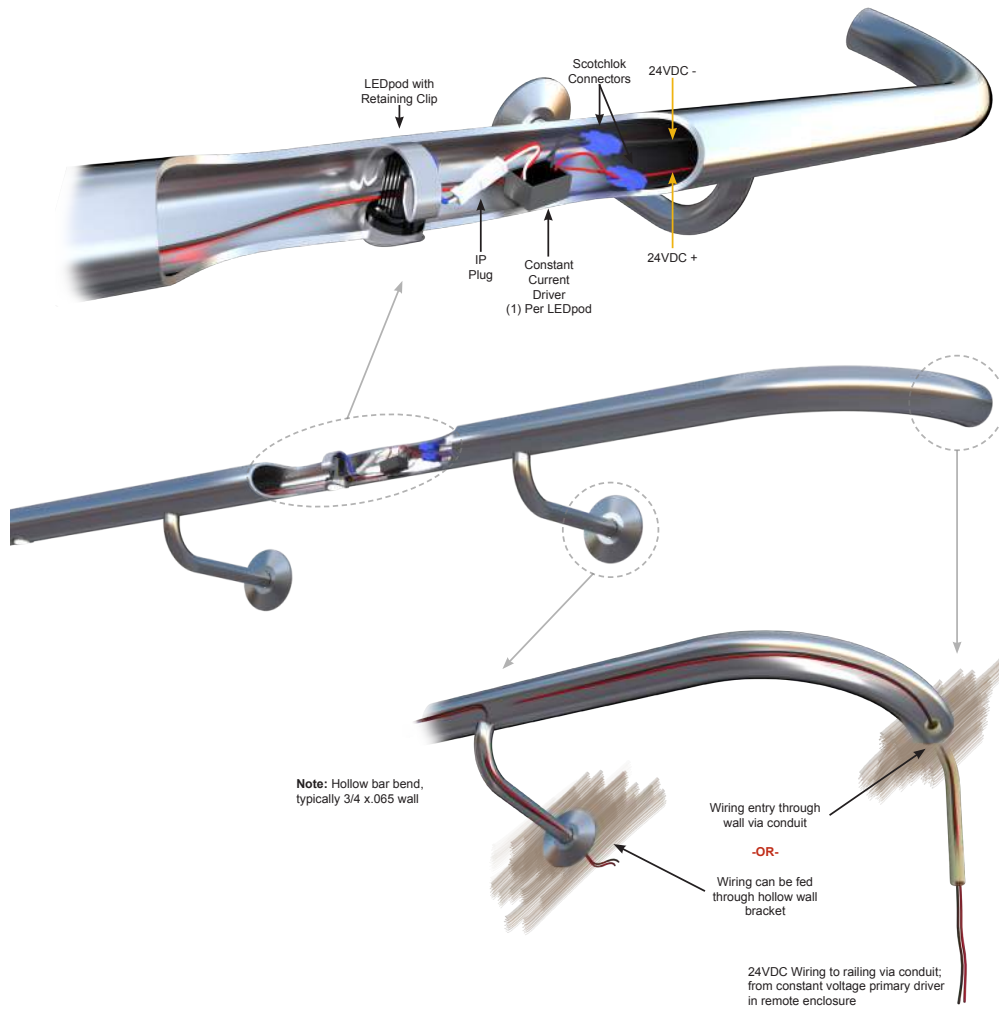
Specifier:

Rep Agency:

Fixture Type:

Product Code:

**Wiring Diagram - Wall Mounted**



R6.0 20190327 | KLIK LEDpod™ 40 | Page 5 of 5

Notes:

Type:

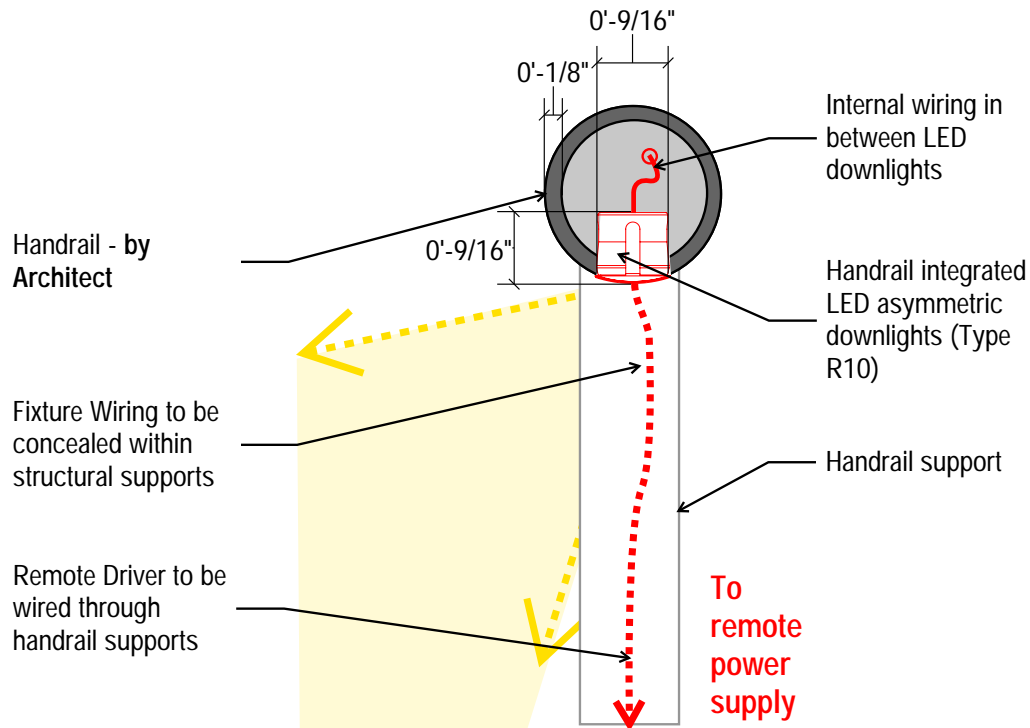
**R10**

Page 5 of 6

**\*FOR DESIGN INTENT ONLY\***

See architectural drawings

Notes:



Detail- Handrail Lighting  
Scale: not to scale

Type:

**R10**

Page 6 of 6



## Function

The LED008001 Slab Hanger Compact White LED Light comes in a compact package. It is designed for situations where visibility of the light fixture needs to be de-emphasized and space near the nozzle is tight (Narrow troughs). Provides gentle lighting of lower effects.

## Specifications

Construction of fixture shall be plastic and 304/316 stainless steel.  
Hardware included:

- LED emitter: 5 W / 350mA.
- Input Voltage: 12 VDC to 24VDC
- 9 ft [2.75m] or 20FT[6m] of type ST or SO submersible cable. Select when ordering.
- Clear lexan lens
- UV stabilized Delrin Top Face
- Optic: Polycarbonate 20°

### 1. Order your LED:

Part No.	Lamp	Color Temperature	Mounting	Application
LED008001	White	5600K (Cool)	Slab Hanger	Wet/Dry
LED008024	White	2600K (Warm)	Slab Hanger	Wet/Dry

\* For specific color temperature contact CF

### 2. Add one of the cables:

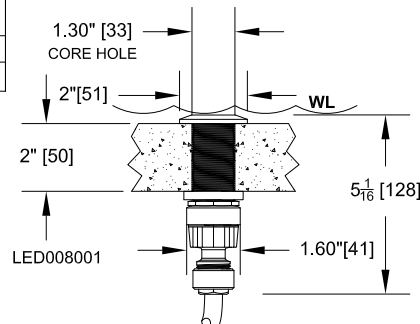
Cable	Part No.
9ft. 16/3 STW	ELCORD007LW09
20ft. 16/3 STW	ELCORD007LW20
European cable	
3m 5x1mm HO5RN-F	ELCORD007MW03
6m 5x1mm HO5RN-F	ELCORD007MW06

## Options:

- EL PKIT10 - DMX/RDM Addressing and Play Show Tool

## Notes

- The light is IP68 rated.
- Fixture must be installed by a qualified electrician in accordance with all state and local codes.
- Connect submersible cable to submersible junction boxes.
- For wiring refer to page 2 and instruction shipped with product.
- Contact Crystal Fountains for detailed specification, installation and operation.



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**12VDC TO 24VDC 5W MAX. Non-Dimmable  
WHITE SLAB HANGER COMPACT LED  
LIGHT**

SERIES  
LED008

REV.  
K  
SEP 2017

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## Notes:

Recessed submersible LED grazing fixture in reflection pond fountain base

Fixture to be  
NON DIM

Architect to confirm Stone Basin dimensions. Fixtures to be coordinated with stone shop drawings.

Provide 2" threaded coupling for integration with stone base.

Provide remote power supply(s) as required. Power supply(s) to be located in a well ventilated, accessible area.

Remote driver(s) to be rated for exterior use. Additional wet location enclosure box and/or direct burial enclosure may be required.

Notes continue on next page....

- ☒ Standard  
☐ Modified Standard  
☐ Custom  
☐ Sample Required

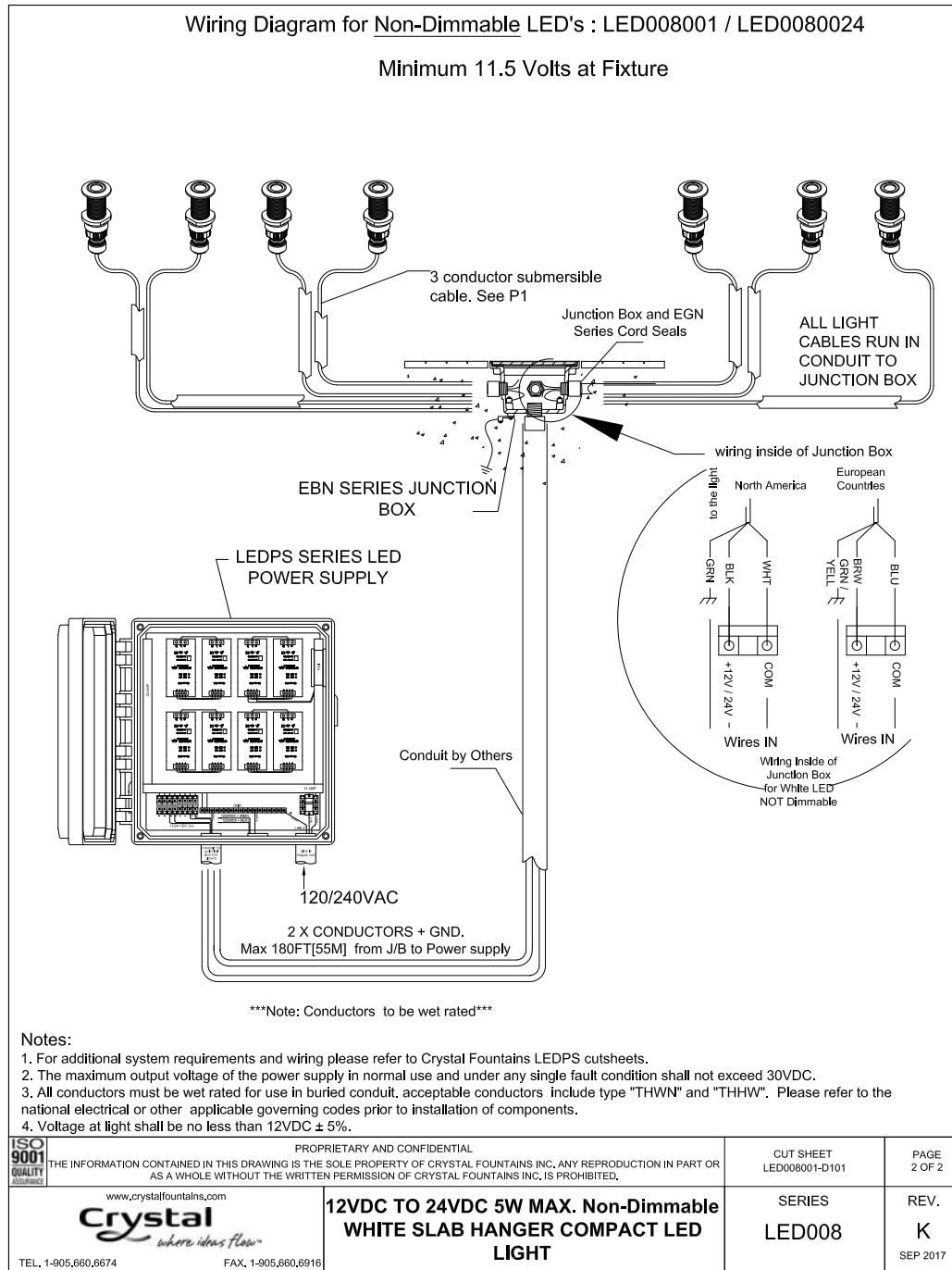
**Manufacturer:** CRYSTAL FOUNTAINS  
**Catalog Number:** LED008024 + LEDPS603-12VDC-960W + ELCORD007LW20 (AS REQ'D) + EBN208A101 (SUBMERSIBLE JBOX AS REQ'D) + EGN075 + PF1316 + EBJ C10  
**Lamp:** 2600K LED (Included)  
**Wattage :** 5W  
**Voltage:** 120V  
**Finish:** Manufacturer Standard Stainless Steel

**Type:**

**R11**

Page 1 of 8

☐ Part of Series



**Notes:**

Low voltage wiring and wet rated J-boxes to contained within Basin

Requires manufacturer provided shop drawing(s) for approval during shop drawing coordination

Refer to manufacturer's recommendations for maximum remote distance to minimize voltage drop

Coordinate leader cables, joiners, terminators and any additional parts as required for a complete installation

Provide 20% of each type and rating installed for Attic Stock. Furnish at least one of each type.

Notes continue on next page...

Type:

**R11**

Page 2 of 8

#### Function

Crystal Fountains LEDPS603 and LEDPS604; White Non Sequencing LED Lighting - Power Supplies are an integral component in an overall LED lighting system including (LED light + Power Supply ). The LEDPS603 (12VDC) and LEDPS604 (24VDC) power supplies are used with Crystal's non Sequencing LED Lighting .They provide 960 watts of power and can work with the following Crystal LED products:

LED008 Light Series	LED170 Light Series	LED260 Light Series
LED040 Light Series	LED180 Light Series	LED150 Dynamite Blast
LED160 Light Series	LED190 Light Series	LED165 Light Series
LED002 Light Series		

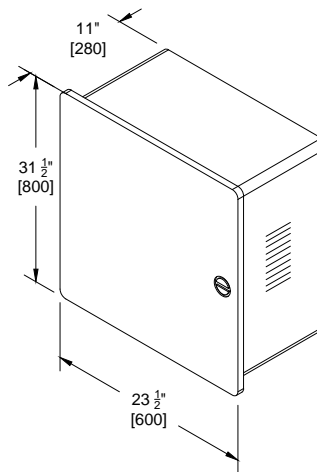
The design of the LEDPS series provides simplified wiring, ensuring system efficiency.

#### Specification

Enclosure - fiberglass or plastic box , NEMA 4  
Input voltages of 115VAC or 230VAC.  
UL508A compliance.  
Power - 960 Watts  
Operating temperature: -10°C to +40°C

#### Notes

1. Outdoor rated.
2. In coming line voltage for LEDPS is 115/230VAC, 10/5 Amp, 50-60Hz.
3. Refer to table for voltage output to LEDs.
4. refer to page 3. for internal wiring and termination diagram
5. The design of all low voltage lighting systems must include a review of voltage drop in relation to the distance of the conductor runs and the size of the conductors being run. For information on specific requirements refer to the cut sheets and installation guides of the specific product being controlled with the LEDPS series power supply
6. Contact Crystal Fountains for detailed specification, installation and operation details.
7. Fixture must be installed by a qualified electrician, in accordance with local and national codes.
8. Not all lighting solutions can be solved using the LEDPS. Please contact Crystal Fountains for custom power supply solutions.



Part No.	Output Voltage	No. of LED's powered	WHITE LED Series (30w)	No. of LED powered	WHITE LED Series (60w)	No. of LED powered	LED Series ( 5W )
LEDPS603	12VDC 80A	24	LED 160,165,170, 180, 190	12	LED260	150	LED008 LED002
LEDPS604	24VDC 40A	24	LED 165	12	LED260		

<b>ISO 9001</b> QUALITY MANAGEMENT SYSTEM CERTIFIED				PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF CRYSTAL FOUNTAINS INC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF CRYSTAL FOUNTAINS INC. IS PROHIBITED.		CUT SHEET LEDPS603-604-D101	PAGE 1 OF 1
www.crystalfountains.com <b>Crystal</b> <i>where ideas flow</i> TEL: 1-905.660.6674 FAX: 1-905.660.6916		<b>12 &amp; 24VDC POWER SUPPLY LEDPS603 AND LEDPS604</b>			SERIES LEDPS	REV. C MAR 2017	

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#### Notes:

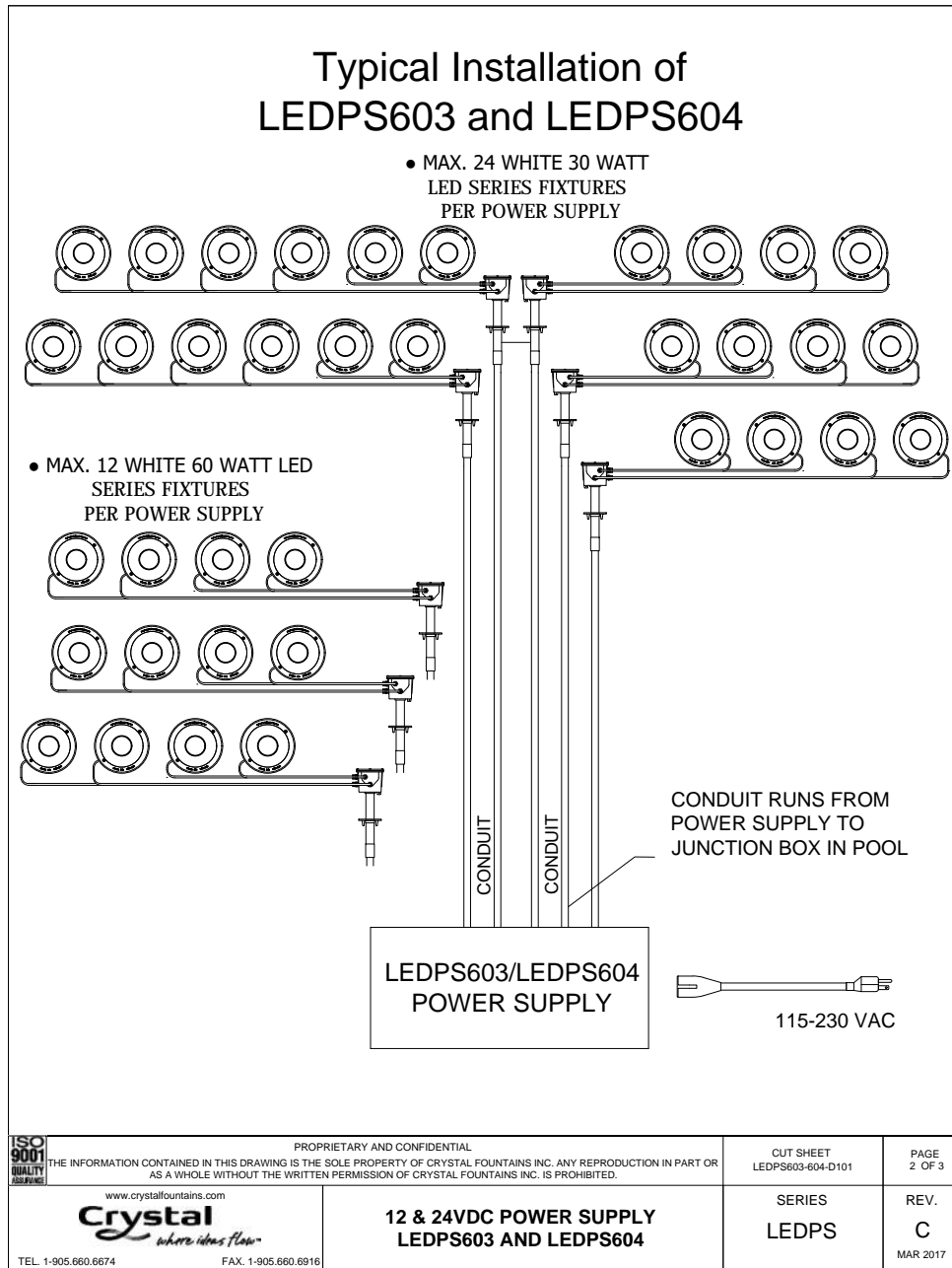
(16) R11 fixtures to be wired to junction box (8 fixtures to each of 2 junction boxes), (1) R11 to be run directly to driver. Manufacturer to confirm.

#### Type:

**R11**

Page 3 of 8

Notes:

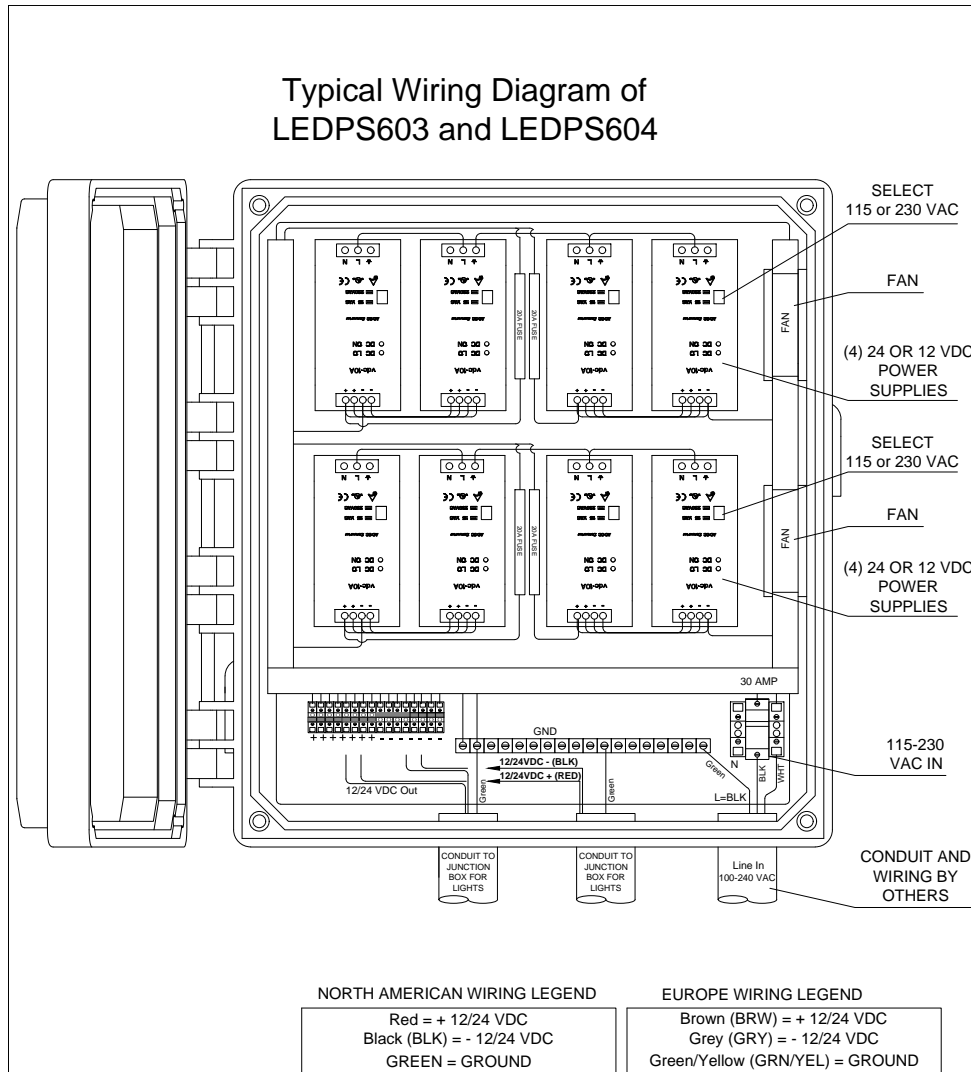


Type:

**R11**

Page 4 of 8

Notes:



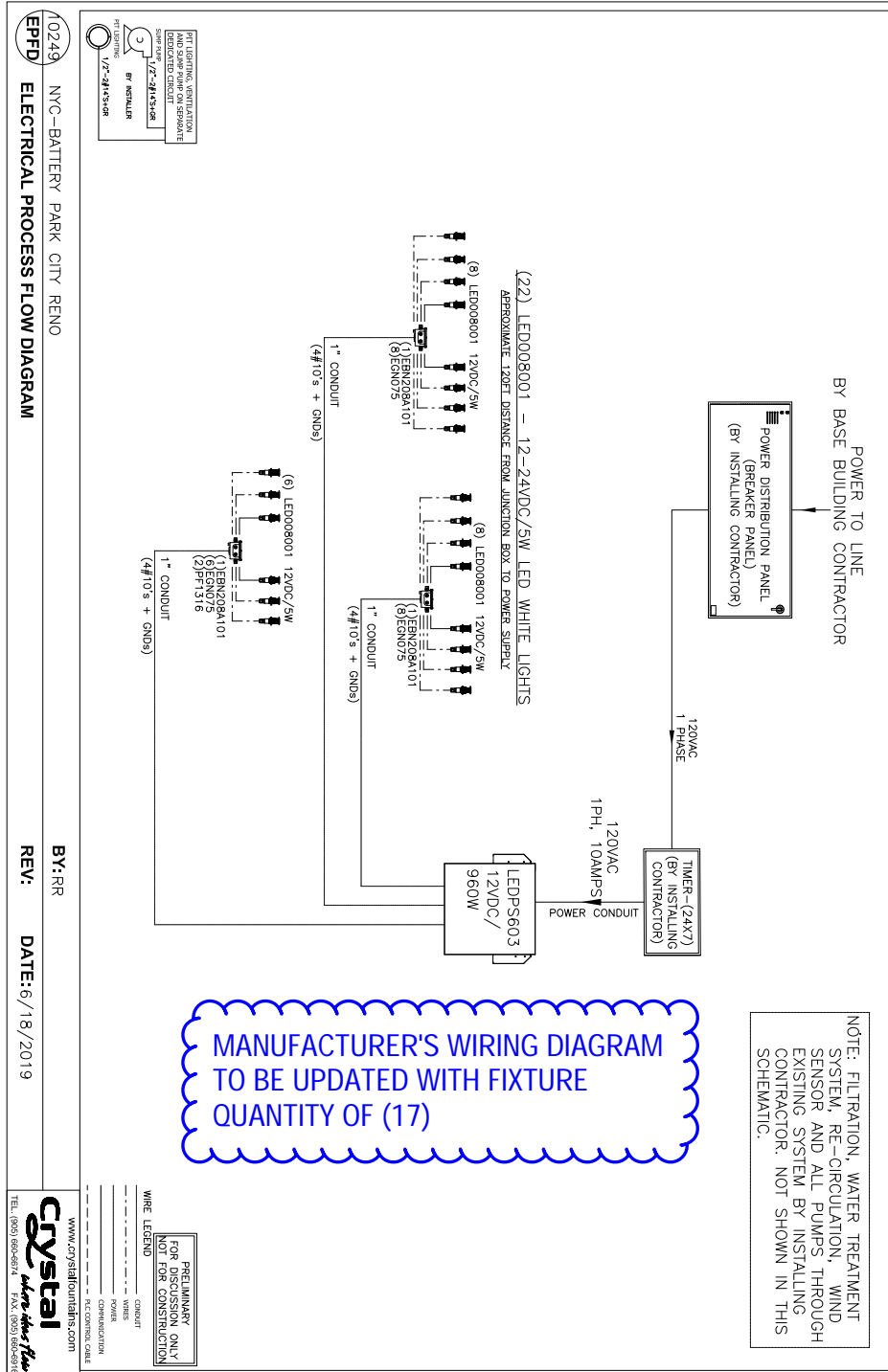
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www.crystalfountains.com <b>Crystal</b> <i>where ideas flow</i> TEL: 1-905.660.6674 FAX: 1-905.660.6916	<b>12 &amp; 24VDC POWER SUPPLY LEDPS603 AND LEDPS604</b>		SERIES LEDPS REV. C MAR 2017

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Type:

**R11**

Page 5 of 8



Notes:

Type:

R11

Page 6 of 8

See architectural drawings

Optional additional curved rim on interior face of lip that can be moved vertically for more precise cutoff if stone tolerance/dimensions are not possible.

Center section to be removable for access to fixtures and junction boxes.  
See architectural drawings

30' - 7"

Largest distance  
(to Northwest corner of pool)

~ 1 degree angle between fixture position and top edge of pool perimeter.  
Light needs to be shielded above 91 degrees to remove light spill onto memorial wall

1.198°

0'-6" 1/4"

0'-6" 1/4"

0'-7" 1/4"

1'-8"

0'-6"

9 7/16"

3"

2"

7/8"

0'-3"

0'-1 5/8"

0'-7"

1'-2"

1-5/8" O.D., 2" Long threaded coupling [1-5/16" threaded I.D.] for integration with fixture

Section - Stone Basin Lighting  
Scale: 3" = 1'-0"

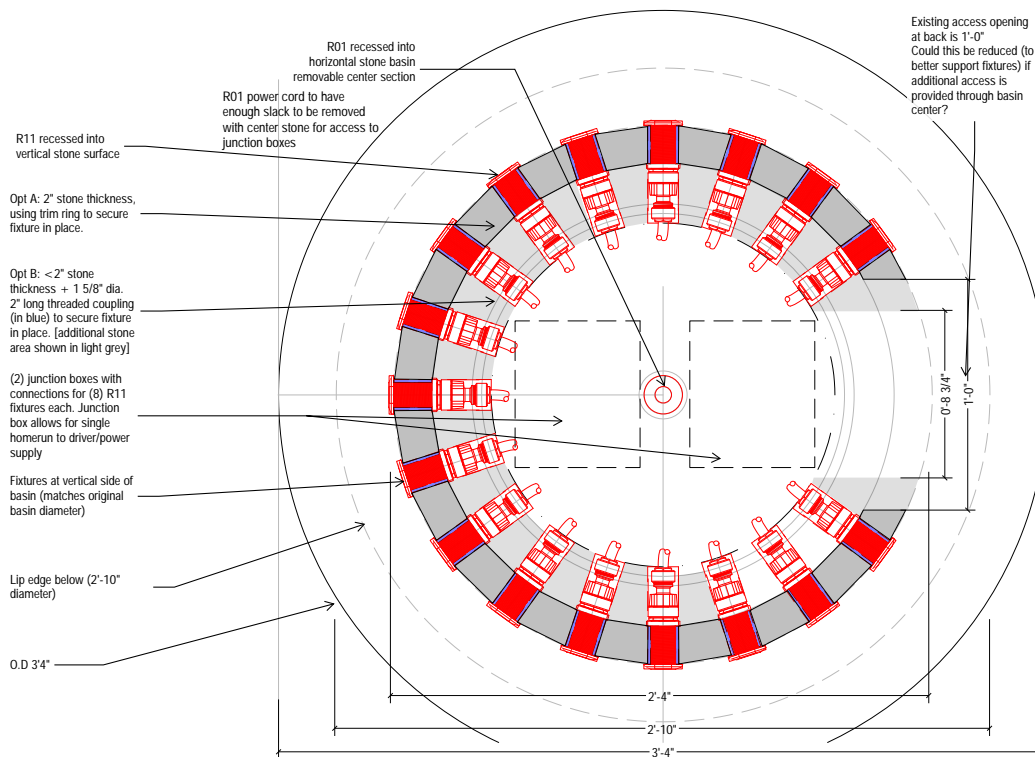
R11

**Renfro** Design Group  
Architectural Lighting Design

**\*FOR DESIGN INTENT ONLY\***

See architectural drawings

Notes:



Type:

**R11**

Page 8 of 8

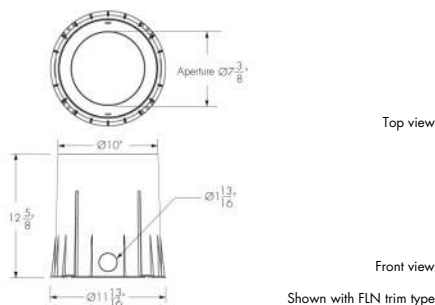


## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

Project Name \_\_\_\_\_ Qty \_\_\_\_\_

Type \_\_\_\_\_ Catalog / Part Number \_\_\_\_\_



### Photometric Summary

Symmetric	Delivered output (lm)	Intensity (peak cd)	Power [1] (120V) [W]
VN (6°)	1695	83,330	30 [4]
NS (10°)	4371 [3]	63,536	60 [2]
M (30°)	4929 [3]	21,162	60 [2]
FL (40°)	4442 [3]	10,611	60 [2]
WFL (60°)	4118 [3]	4157	60 [2]

Bi-symmetric	Delivered output (lm)	Intensity (peak cd)	Power [1] (120V) [W]
6°x90°	1585	8136	30 [4]
90°x6°			
15°x90°	3670 [3]	9152	60 [2]
90°x15°			
25°x90°	3836 [3]	5471	60 [2]
90°x25°			
35°x90°	3396 [3]	3536	60 [2]
90°x35°			

Asymmetric	Delivered output (lm)	Intensity (peak cd)	Power [1] (120V) [W]
NAS	1713	26,491	30 [4]
WW	2182	3250	36 [2]

Based on 4000K, On/Off configuration. Tested with IFR lens for VN optic, SFR lens for NAS, WW optics and CL lens for all other optics.

Photometric performance is measured in compliance with IESNA LM 79-08. Consult photometric files for static color information.

- [1] Add 5 W per fixture when specifying DMX/RDM.  
[2] Use 39 W when specifying luminaire for white light.  
[3] 70% output for luminaire, 80% output for DALI when specifying white light.  
[4] Use 32 W when specifying luminaire for VN, 6°x90°, 90°x6° and NAS.

### Description

The lumenbeam Inground Large is a high-performance, ground-recessed LED projector designed to solve a range of inground lighting challenges with a choice of optics, trim, lenses and control options. The plug and play design simplifies installation, protecting the system from water infiltration and ensuring long-lasting performance. Built with robust, high-quality materials, with an option of resistance to harsh environments, the lumenbeam Inground Large delivers L70 LED lifetimes from 79,000 up to 370,000 hours, has a Drive-Over rating of 5000kg, IK10 glass lens and an IP68 factory-sealed optical chamber.

### Features

<b>Construction</b>	Walk over compliant up to 1000 kg in any type of ground, Drive over compliant up to 5000 kg in concrete
<b>Color and Color Temperature</b>	2200K, 2700K, 3000K, 3500K, 4000K, 5700K, Red, Green, Blue
<b>Optics (nominal distribution)</b>	VN (6°), NS (10°), M (30°), FL (40°), WFL (60°), 6° x 90°, 15° x 90°, 25° x 90°, 35° x 90°, 90° x 6°, 90° x 15°, 90° x 25°, 90° x 35°, NAS (Narrow Asymmetric), WW (Asymmetric Wallwash)
<b>Lens</b>	Clear lens, Small frosted ring, Large frosted ring, Softening lens, (lens type will vary according to optic, see optics and lens section)
<b>Optical Option (factory installed)</b>	Internal louver
<b>Trim Type</b>	Flush trim with hardware, Flush trim no hardware, Bevel edge trim with hardware, Bevel edge trim no hardware
<b>Blockout</b>	Recessed blockout, Recessed blockout with mounting brackets
<b>Options</b>	Anti-slip lens, Brass material suitable for harsh environments
<b>Adjustment</b>	-3° to +15° tilt, 360° rotation
<b>Power Consumption</b>	30 W to 60 W
<b>Warranty</b>	5-year limited warranty

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1 / 14

### Notes:

Recessed adjustable  
LED Flood beam  
uplight at Flag Poles

Fixture to be  
NON DIM

Possible MOD for  
bottom power feed  
(to be confirmed with  
site conditions)

Fixture has Integral  
Driver

Architect to confirm  
asphalt pavers  
thickness to confirm  
Trim

Notes continue on  
next page...

**Alternates:**  
LUMASCAPE:

LS363LED-16H6-G-I-  
82-M-21-Q-09

- ☐ Standard  
☒ Modified Standard  
☐ Custom  
☐ Sample Required

Manufacturer: LUMENPULSE  
Catalog Number: LBIL-DO-120/277-30K-M-CL-INTL-NO-FLH-SSB-RBM-ASL-HRS-UL

Lamp: 3000K LED (Included)  
Wattage : 30W  
Voltage: 120V  
Finish: Brushed Stainless Steel, Architect to Confirm

Type:

**R12**

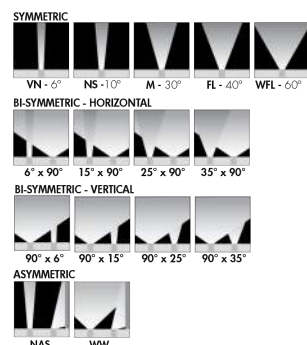
Page 1 of 14

☐ Part of Series

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

### Optics



### Colors and Color Temperatures



### Controls



### Construction



### Trim Finishes



### Options



### Ratings



### Performance

Maximum Delivered Output	4929 lm (4000K, M 30°, CL lens, On/Off control)
Maximum Delivered Intensity	83,330 cd at nadir (4000K, VN 6°, LFR lens, On/Off control)
Illuminance at Distance	Minimum 1 fc at 288 ft (4000K, VN 6°, LFR lens, On/Off control)
Color Consistency	2 SDCM, 3 SDCM (2200K and 5700K)
Color Rendering	Minimum CRI 80
Lumen Maintenance	L70 79,000 to 370,000 hrs (Ta 25 °C), L70 77,000 to 90,500 hrs (Ta 40 °C)

### Physical

Optical Chamber Material	Aluminum for walk-over and drive-over construction, Brass for walk-over and drive-over construction in harsh environments
Blockout Material	Fiberglass reinforced polymer
Lens Material	Tempered glass
Hardware Material	Stainless steel
Gasket Material	Silicone
Trim Finish	Brushed stainless steel, Polished stainless steel
Weight	20 lbs for standard construction (aluminum housing), 23 lbs for harsh environment option construction (brass housing)

### Electrical and control

Voltage	120-277 volts, 220-240 volts
Leader Cable Conductor	6C #14-3/ #24-3
Leader Cable Connector	IP68 6-pin push-lock
Control	On/Off control, Lumentalk, 0-10V dimming, DALI dimming, DMX/RDM enabled
Resolution (DMX/RDM)	Per fixture, 8-bit or 16-bit

### Environmental

Storage Temperature	-40 °F to 185 °F (device must reach start-up temperature value before operating)
Start-up Temperature	-13 °F to 104 °F
Operating Temperature	-40 °F to 104 °F, Consult factory for -40 °F to 122 °F temperature range
Ingress Protection Rating	IP68 (submerged up to 3.3 ft for up to 24 hours), not suitable for permanent immersion applications
Impact Resistance Rating	IK10
Environment	Wet location

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2 / 14

### Notes:

Requires manufacturer provided shop drawing(s) for approval during shop drawing coordination

Coordinate leader cables, joiners, terminators and any additional parts as required for a complete installation

Architect to confirm finish

Manufacturer to confirm recommended parts/fixtures as attic stock. Furnish at least one fixture.

### Type:

**R12**

Page 2 of 14

## Specification Sheet

### lumenbeam

Inground Large  
LBIL

WHITE AND STATIC COLORS

## Notes:

### Certifications



### Accessories (order separately)

Cables	3 Conductor Power and 3 Conductor Data Leader Cable with Connector, 3 Conductor Power and 3 Conductor Data Cable
Electrical Accessories	Large Junction Box for Lumenbeam Inground
Control Boxes	DMX/RDM enabled (daisy chain or star configuration), Ethernet enabled (daisy chain or star configuration)
Control Systems	Lumentone™ 2, Pharos® kit
Diagnostic and Addressing Tools	LumenID, LumentalkID

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3 / 14

## Type:

# R12



Page 3 of 14

Notes:

Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

Construction details

	WO - Walk over compliant up to 1000kg	DO - Drive over compliant up to 5000kg		Standard construction	HRS - Brass material suitable for harsh environments
Trim type	All trim options are suitable (FLH, FLN, BVH and BVN)	Only trim options with visible hardware are suitable (FLH and BVH)	Optical chamber housing material	 Aluminum	 Brass
Ground type	Installed in sand, soft soil, compacted soil, pavement or concrete	Installed in concrete	Installation environment	Locations without de-icing salt or non-coastal zones	All locations

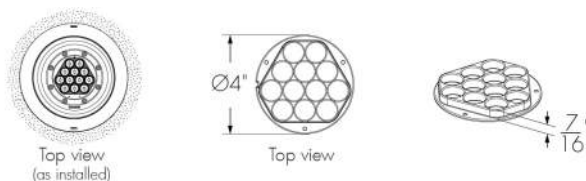
Optics and lens options

Optics / Lens	Clear	Small frosted ring	Large frosted ring	Softening	Anti-slip
VN			<input checked="" type="checkbox"/>		
NS/M/FL/WFL	<input checked="" type="checkbox"/>				
6° / 15° / 25° / 35° x 90°	<input checked="" type="checkbox"/>				
NAS/WW		<input checked="" type="checkbox"/>			

☒ Recommended for optimal performance, may be replaced by a softening lens. A softening lens will affect beam distribution and output. Consult factory for application support.

Optical accessories (factory installed)

INTL - Internal louver



- The internal louver is factory installed and not adjustable in the field.
- Not available for NAS, WW optics.
- The addition of an internal louver will affect beam distribution, consult factory for application support.

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4 / 14

Type:

**R12**

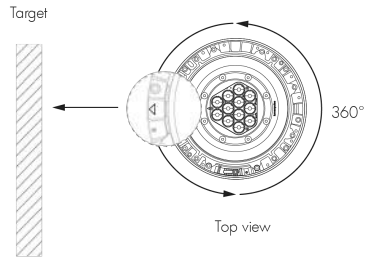
Page 4 of 14

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

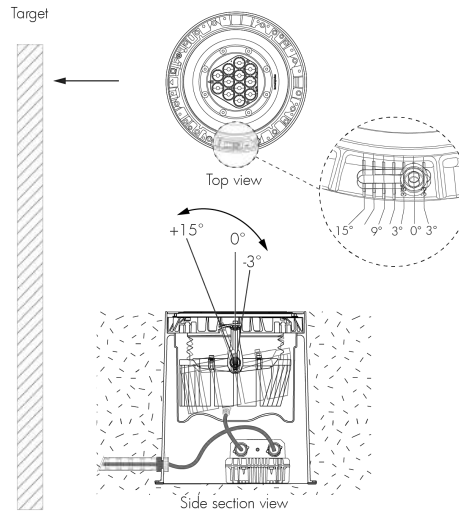
### Adjustment

#### 360° Orientation



The optical chamber can be rotated until the arrow faces the target.  
Refer to the installation instructions for details.

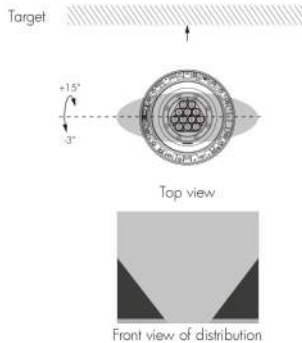
#### -3° to +15° Tilt adjustment



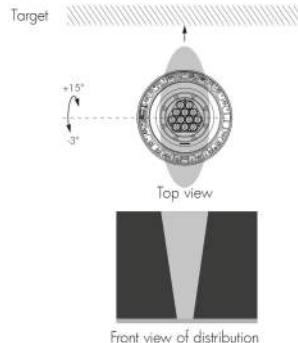
- Tilt can be adjusted on site without opening the factory sealed optical chamber.
- **Asymmetrical optics:** Tilt set in factory for optimal results (WW at 5° and NAS at 3°).

### Bi-symmetrical distributions

Horizontal distribution : 6°x90°, 15°x90°, 25°x90°, 35°x90°



Vertical distribution : 90°x6°, 90°x15°, 90°x25°, 90°x35°



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5 / 14

Notes:

Type:

**R12**

Page 5 of 14

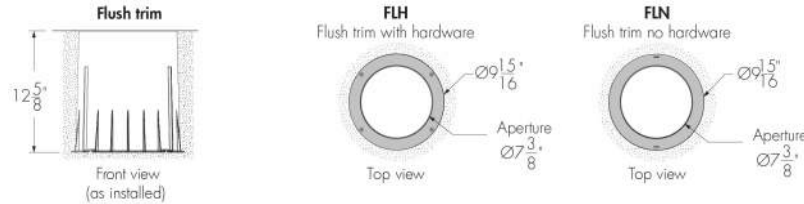
## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

Notes:

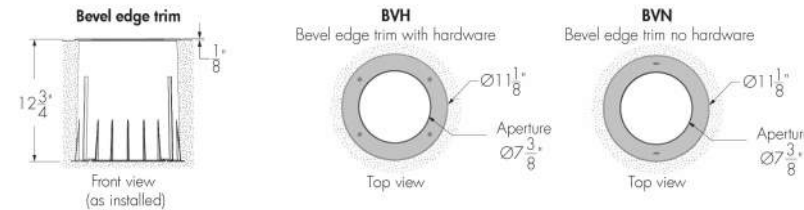
### Trim type

Flush trim



Only trims with hardware are drive-over compliant.

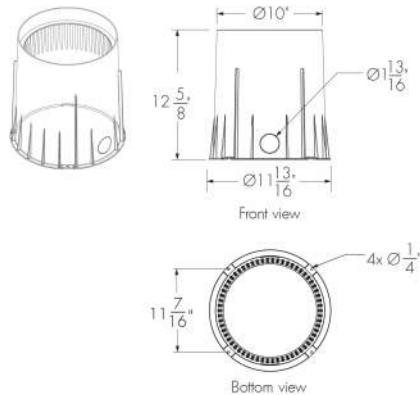
Bevel edge trim



### Blockout

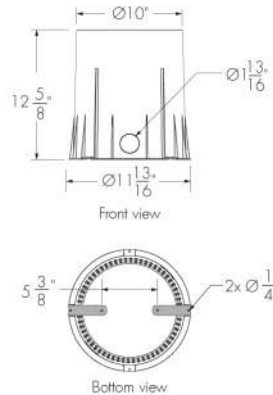
RBO - Recessed Blockout

RBO - Recessed blockout



RBM - Recessed Blockout with Mounting Brackets

RBM - Recessed blockout with mounting brackets



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6 / 14

Type:

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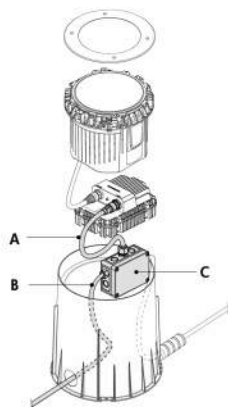
Page 6 of 14

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

## Notes:

### Overview - cables and accessories



**A - 3P3DLC:** 3 Conductor Power and 3 Conductor Data Leader Cable with Connector

**B - 3P3DC:** 3 Conductor Power and 3 Conductor Data Cable

**C - LBI-JBOX-L:** Large Junction Box for Lumenbeam Inground (required for continuous run)

Refer to typical wiring diagrams for details.

### Cables (order separately)

**3P3DLC - 3 Conductor Power and 3 Conductor Data Leader Cable with Connector**



**CERTIFICATION:** UL or CE  
**LENGTH:** 10 ft, 25 ft or 50 ft

- Sealing endcap is mandatory for all unused connectors. One (1) included with every leader cable.
- Consult 3P3DLC specification sheet for details.

**3P3DC - 3 Conductor Power and 3 Conductor Data Cable**



**CERTIFICATION:** UL or CE  
**LENGTH:** 50 ft, 100 ft, 150 ft, 200 ft or complete spool of cable 250 ft

### Electrical accessories (order separately)

**LBI-JBOX-L - Large Junction Box for Lumenbeam Inground (required for continuous run)**



#### Included

- 1x Junction box with 16 in 3P3DLC cable whip
- 4x Strain reliefs
- 1x IP68 insulating resin
- 1x Sealing cap

Refer to LBI-JBOX-L installation instructions for details.

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7 / 14

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Page 7 of 14

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

## Notes:

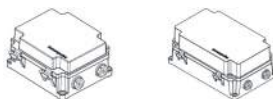
### Control boxes (order separately)

#### CBX-DMX/RDM - DMX/RDM enabled (daisy chain or star configuration)



DMX/RDM control box. Up to six power and data outputs to fixtures or fixture runs. Consult CBX specification sheet and installation instructions for details. Lumenterminators provided with CBX (2x for daisy chain configuration, 6x for star configuration), consult factory to order spares.

#### CBX-ENET - Ethernet enabled (daisy chain or star configuration)



Ethernet control box. Up to four power and data outputs to fixture or fixture runs. Consult Ethernet CBX specification sheet and installation instructions for details.

### Control systems (order separately)

#### LTN2 - Lumentone™ 2



Lumentone 2 is a simple pre-programmed DMX 512 controller with a push button rotary dial and live feedback.

#### PHAROS - Pharos® kit



The Pharos kit, available for 1 or 2 DMX universes, allows for complete control of large lighting installations. 2 DMX universes kit shown.

### Diagnostic and addressing tools (order separately)

#### LID - LumenID



LumenID is a diagnostic and addressing DMX/RDM tool. It must be specified on all DMX applications. Consult LID specification sheet for details.

#### LID-LT - LumentalkID



LumentalkID is a diagnostic and addressing tool. It must be specified for all Lumentalk (LT) applications. Consult LID-LT specification sheet for details.

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8 / 14

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Page 8 of 14

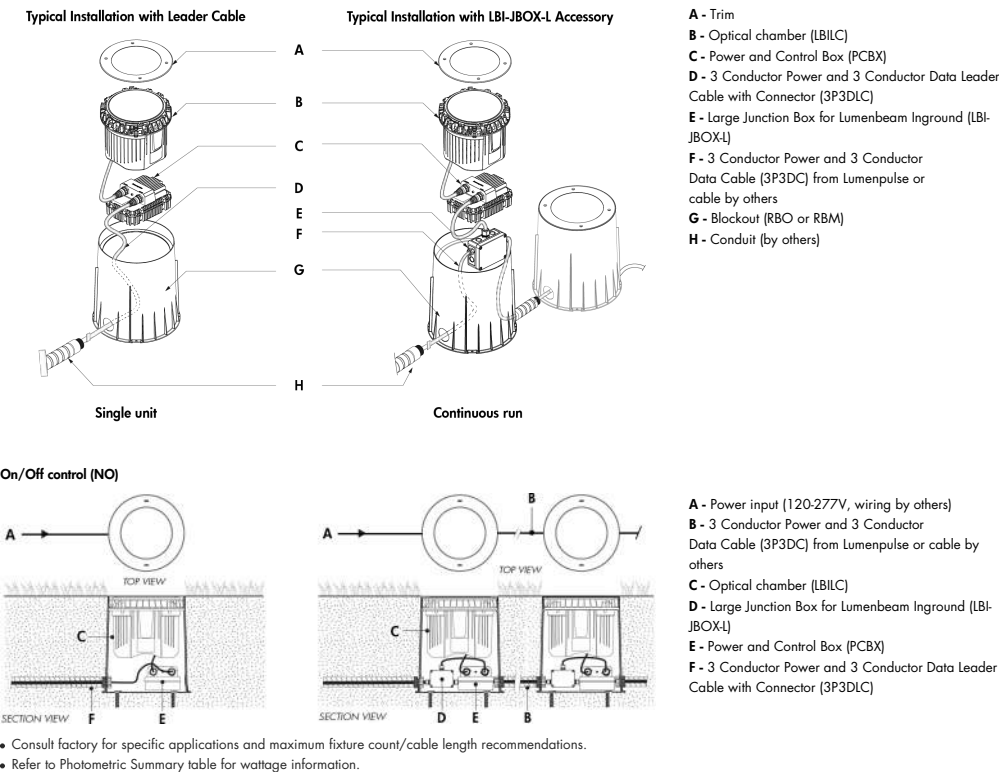


Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

Notes:

Typical wiring diagrams



Type:

R12

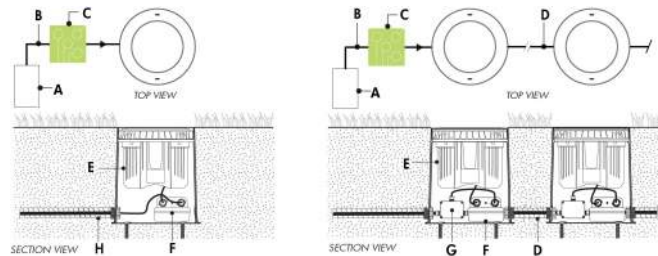
Page 9 of 14

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

## Notes:

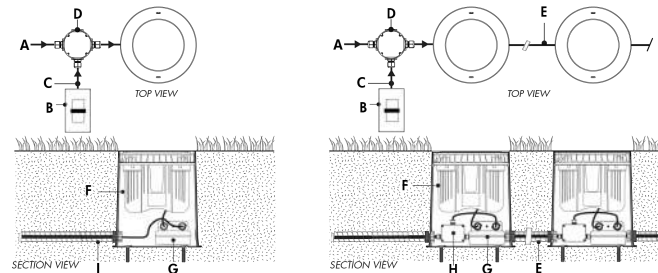
### Lumentalk (LT)



- A - Dimmer/controller (order separately from Lumenpulse, or by others)
- B - Data wiring (by others)
- C - Lumentranslator 2 (LT2 -010, -DMX, -TRIAC, -DALI)
- D - 3 Conductor Power and 3 Conductor Data Cable (3P3DC) from Lumenpulse or cable by others
- E - Optical chamber (LBILC)
- F - Power and Control Box (PCBX)
- G - Large Junction Box for Lumenbeam Inground (LBI-JBOX-L)
- H - 3 Conductor Power and 3 Conductor Data Leader Cable with Connector (3P3DLC)

- Consult factory for specific applications and maximum fixture count/cable length recommendations.
- Lumentalk enabled fixtures must be commissioned using LumentalkID software and a LID-LT. Consult factory for details.
- Maximum of 1 transmitter (Lumentranslator or Lumenlink) per system. No third party fixtures allowed on the same circuit.
- For DMX applications: 1 DMX controller per Lumentalk network, maximum of 48 DMX channels per Lumentalk network (minimum step transition update rate is 1 second, minimum fade time between two colors is 1 minute). Consult factory for applications that require additional capabilities.
- Consult factory for DALI Lumentalk applications.
- 1% minimum dimming value. Refer to Photometric Summary table for wattage information.

### 0-10V dimming (DIM)



- A - Power input (120-277V, wiring by others)
- B - Dimmer (by others)
- C - Data wiring (by others)
- D - Junction box (by others)
- E - 3 Conductor Power and 3 Conductor Data Cable (3P3DC) from Lumenpulse or cable by others
- F - Optical chamber (LBILC)
- G - Power and Control Box (PCBX)
- H - Large Junction Box for Lumenbeam Inground (LBI-JBOX-L)
- I - 3 Conductor Power and 3 Conductor Data Leader Cable with Connector (3P3DLC)

- Consult factory for specific applications and maximum fixture count/cable length recommendations.
- 0-10V mA ratings: passive dimmer (Current Sink): 3mA per fixture, active dimmer (Current Source): 0.5mA per fixture.
- 10% minimum dimming value. Refer to Photometric Summary table for wattage information.

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10 / 14

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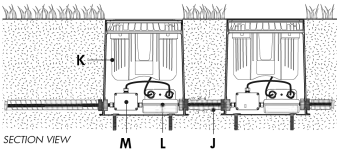
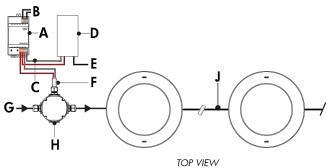
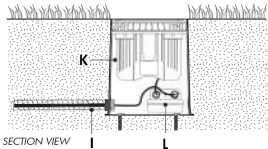
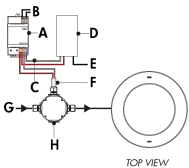
Page 10 of 14

Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

Notes:

DAI dimming (DAI)



- A - DAI bus power supply (by others)
- B - Power input for DAI bus power supply (wiring by others)
- C - To DAI controller (by others)
- D - DAI controller (by others)
- E - Power input for DAI controller (wiring by others)
- F - To fixture
- G - Power input (120-277V, wiring by others)
- H - Junction box (by others)
- I - 3 Conductor Power and 3 Conductor Data Leader Cable with Connector (3P3DLC)
- J - 3 Conductor Power and 3 Conductor Data Cable (3P3DC) from Lumenpulse or cable by others
- K - Optical chamber (LBILC)
- L - Power and Control Box (PCBX)
- M - Large Junction Box for Lumenbeam Inground (LBIL-JBOX-L)

- Consult factory for specific applications and maximum fixture count/cable length recommendations.
- Maximum of 64 DAI fixtures per DAI loop.
- The Lumenbeam Inground Large responds to RGBWAF controls.
- Commissioning may be required based on the selection of 3rd party DAI controller. Controller and commissioning provided by others.
- Refer to Photometric Summary table for wattage information.

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11 / 14

Type:

**R12**

Page 11 of 14

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

## Notes:

How to order							
1	2	3	4	5	6	7	8
9	10	11	12	13			

### 1. Housing <sup>(1)</sup>

**LBIL** Lumenbeam Inground Large

<sup>(1)</sup> A Lumenbeam Inground fixture includes one optical chamber (LBILC), one Power and Control Box (PCBX), one recessed blackout with temporary blackout cover (RBO or RBM) and one trim (FLH, FLN, BVH or BVN). The LBILC and PCBX are provided according to the optic and control configuration.

### 2. Construction

**WO** Walk over  
**DO** Drive over <sup>(1)</sup>

<sup>(1)</sup> A trim option with hardware (FLH or BVH) must be specified for DO construction.

### 3. Voltage

**120/277** 120-277 volts <sup>(1)</sup>  
**220/240** 220-240 volts <sup>(2)</sup>

<sup>(1)</sup> Available for UL certification only.

<sup>(2)</sup> Available for CE certification only.

### 4. Color and Color Temperature <sup>(1)</sup>

**22K** 2200K  
**27K** 2700K  
**30K** 3000K  
**35K** 3500K  
**40K** 4000K  
**57K** 5700K  
**RD** Red <sup>(2)</sup>  
**GR** Green <sup>(2)</sup>  
**BL** Blue <sup>(2)</sup>

<sup>(1)</sup> Consult factory for availability of static Royal Blue, Amber, 6500K and 90+ CRI.

<sup>(2)</sup> Static colors made to order 8-10 weeks.

### 5. Optics

**VN** Very Narrow 6°  
**NS** Narrow Spot 10°  
**M** Medium 30°  
**FL** Flood 40°  
**WFL** Wide Flood 60°  
**6x90** 6° vertical x 90° horizontal  
**15x90** 15° vertical x 90° horizontal  
**25x90** 25° vertical x 90° horizontal  
**35x90** 35° vertical x 90° horizontal  
**90x6** 90° vertical x 6° horizontal  
**90x15** 90° vertical x 15° horizontal  
**90x25** 90° vertical x 25° horizontal  
**90x35** 90° vertical x 35° horizontal  
**NAS** Narrow Asymmetric  
**WW** Asymmetric Wallwash

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13 / 14

Type:

**R12**

Page 12 of 14

## Specification Sheet

**lumenbeam**  
Inground Large  
LBIL  
WHITE AND STATIC COLORS

## Notes:

### 6 . Lens <sup>(1)</sup>

<b>CL</b>	Clear lens <sup>(2)</sup>
<b>SFR</b>	Small frosted ring <sup>(3)</sup>
<b>LFR</b>	Large frosted ring <sup>(4)</sup>
<b>SL</b>	Softening lens <sup>(5)</sup>

<sup>(1)</sup> Consult Optics and Lens Options section for details.

<sup>(2)</sup> Available for all optics except VN, NAS and WW.

<sup>(3)</sup> Available for NAS and WW optics only.

<sup>(4)</sup> Available for VN optic only.

<sup>(5)</sup> Available as an alternate lens choice for all optics. A softening lens will affect beam distribution and output. Consult factory for application support.

### 9 . Trim Type

<b>FLH</b>	Flush trim with hardware
<b>FLN</b>	Flush trim no hardware <sup>(1)</sup>
<b>BVH</b>	Bevel edge trim with hardware
<b>BVN</b>	Bevel edge trim no hardware <sup>(1)</sup>

<sup>(1)</sup> Not available for DO construction.

### 12 . Options

<b>ASL</b>	Anti-slip lens
<b>HRS</b>	Brass material suitable for harsh environments

### 7 . Optical Options

<b>INTL</b>	Internal louver <sup>(1)</sup>
-------------	--------------------------------

<sup>(1)</sup> Not available for NAS and WW optics.

### 8 . Control <sup>(1)</sup>

<b>NO</b>	On/Off control
<b>LT</b>	Lumentalk <sup>(2)</sup>
<b>DIM</b>	0-10V dimming
<b>DALI</b>	DALI dimming
<b>DMX/RDM</b>	DMX/RDM enabled <sup>(3)</sup>

<sup>(1)</sup> Wattage and output may vary according to control option. Refer to Photometric Summary table for details.

<sup>(2)</sup> A Lumentranslator 2 and LumentalkID (LIDLT) must be specified for Lumentalk applications. Consult Lumentranslator 2 and Lumentalk pages and specification sheets for details.

<sup>(3)</sup> A control box (CBX) and LumenID (LID) must be specified.

### 10 . Trim Finish

<b>SSB</b>	Brushed stainless steel
<b>SSP</b>	Polished stainless steel

### 11 . Blockout

<b>RBO</b>	Recessed blockout
<b>RBM</b>	Recessed blockout with mounting brackets

### 13 . Certification

<b>UL</b>	UL compliant
<b>CE</b>	CE compliant <sup>(1)</sup>

<sup>(1)</sup> Consult European specification sheet and installation instructions for CE wiring information.

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14 / 14

Type:

**R12**

Page 13 of 14



Type:

R12

Page 14 of 14

**END OF SECTION 265100**

## **SECTION 321440 - STONE PAVING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

**A. Section Includes:**

1. Stone paving and cobblestones.

**B. Related Requirements:**

1. Section 033000 "Cast-in-Place Concrete" for concrete slabs.
2. Section 044200 "Exterior Stone Cladding" for exterior stone cladding.
3. Section 079200 "Joint Sealants" for sealing joints in stone cladding system with elastomeric sealants.

#### **1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference:** Conduct conference at Project site.

#### **1.3 ACTION SUBMITTALS**

**A. Product Data:**

1. For materials other than water and aggregates.
2. For the following:
  - a. Stone pavers.
  - b. Stone cobblestones.
  - c. Stair treads.
  - d. Mortar and grout materials.

- B. Sieve Analyses:** For aggregate setting-bed materials, according to ASTM C136.

- C. Samples for Initial Selection:** For joint materials involving color selection.

- D. Stone Samples for Verification:** Sets for each variety, color, and finish of stone required; not less than 12 inches square.

1. Sets shall consist of at least three Samples, exhibiting extremes of the full range of color and other visual characteristics expected and will establish the standard by which stone will be judged.

- E. Sealant Samples for Verification:** For each type and color of joint sealant required.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data:** For Installer.

- A. Material Test Reports:**



1. Stone Test Reports: For each stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous three years.
  2. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer complying with requirements in Section 079200 "Joint Sealants" and indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.

#### 1.5 QUALITY ASSURANCE

- A. Supplier Qualifications: Supplier shall have adequate stock to complete the work within allotted time and allow for breakage, waste, and rejection of stone that does not satisfy requirements for appearance of physical properties.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone paving similar to that required for this Project and whose products have a record of successful in-service performance. Fabricator shall have the capacity to process material in accordance with the project schedule.
- C. Installer Qualifications: A firm or individual experienced in installing stone paving similar in material, design, and extent to that indicated for this Project, with a verifiable, 10-year record of successful in-service performance.
- D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.6 PRECONSTRUCTION TESTING

- A. Employ a qualified testing agency to test physical and mechanical properties of stone, determine load capacities, and report results.
- B. Stone Testing: Take test specimens from blocks of stone reserved for the Project. Do not test typical quarry samples. Test stone for the following properties:
1. Absorption by Weight: ASTM C97.
  2. Density: ASTM C97.
  3. Compressive Strength: ASTM C170.
  4. Modulus of Rupture (Stones 2-1/4 inches and thicker): ASTM C99.
  5. Flexural Strength (Stones under 2-1/4 inches thick): ASTM C880.
- C. Preconstruction Sealant Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Section 079200 "Joint Sealants," Samples of materials that will contact or affect joint sealants.

- D. Preconstruction Field Testing of Sealants: Before installing joint sealants, field test their adhesion to joint substrates according to Section 079200 "Joint Sealants."

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
  - 1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
  - 2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.
- B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.

#### 1.8 FIELD CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Mortar and Grout:
  - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
  - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg and higher.
    - a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set pavers within 1 minute of spreading setting-bed mortar.
- C. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F or when joint substrates are wet.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations for Stone: Obtain each variety of stone from single quarry with resources to provide materials of consistent quality in appearance and physical properties.
- B. Source Limitations for Other Materials: Obtain each type of stone accessory, sealant, and other material from single manufacturer for each product.

### **2.2 STONE PAVERS**

- A. Granite Pavers: Paving slabs made from granite complying with ASTM C615/C615M.
  - 1. Varieties and Sources: As follows:
    - a. Type B: Stony Creek, as quarried in Branford, Connecticut.
  - 2. Finish: Polished at bench tops; thermal at other units.
- B. Granite Cobblestones: Fairly rectangular paving stones, with split or thermal-finished faces and edges, made from granite complying with ASTM C615/C615M.
  - 1. Varieties and Sources: As follows:
    - a. Type C: Cambrian Black, as quarried in Alma, Quebec, Canada.
  - 2. Finish: Thermal-finished tops, quarry-split edges, sawed bottoms, and sawed surfaces that are to be adhesive-bonded to each other or to waterproofed pool floor. Cut kerfs in cobblestones that are to be fitted and adhesive-bonded to existing stainless steel support grid.
- A. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
- B. Match existing stone for color, finish, and other stone characteristics relating to aesthetic effects.
- C. Thickness: Not less than 3 cm unless otherwise indicated.

### **2.3 ACCESSORIES**

- A. Pedestal Cushions: Resilient pads that are unaffected by freeze-thaw cycles, ozone, humidity, or water absorption; furnished by the stone setter to support and cushion pavers.
  - 1. Basis-of-Design: Terra-Tabs and Terra-Shims as manufactured by Terra Paving Products.
- B. Sealants for Joints in Stone Paving: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and do not stain stone:
  - 1. Joint Sealant: Urethane, nonstaining, M, NS, 50, T, NT, M, A, and O.
  - 2. Joint-Sealant Colors: As selected by Architect from manufacturer's full range of colors.

- C. Epoxy Resin Adhesive: Two-component, high-modulus adhesive complying with ASTM C881, compatible with and capable of bonding to pool waterproofing.
  - 1. Basis-of-Design: Sikadur 31 Hi-Mod Gel as manufactured by Sika Corp.

## 2.4 MORTAR MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I, white, non-staining, with not more than 0.60 percent total alkali when tested per ASTM C114; use single brand and source for all work.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Sand: ASTM C144.
- D. Coloring Agent: Non-fading, limeproof, natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes, with a record of satisfactory performance in stone mortars.
- E. Water: Potable, free from harmful amounts of acids, alkalis, and organic materials that affect mortar performance or cause efflorescence or staining.

## 2.5 MORTAR MIXES

- A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce mortar of uniform quality and with optimal performance characteristics. Discard mortar that has reached initial set before being used.
- B. Portland Cement-Lime Mortar: Type M complying with ASTM C270, Proportion Specification.
  - 1. Add coloring agent to pointing mortar to produce selected colors. Limit coloring agent to 10 percent of portland cement weight.
- C. Mixing: Mix materials in a clean mechanical batch mixer. First blend dry materials, then add water.
- D. Cold Weather Provisions: Heat mixing water when air temperature is below 40 degrees F and heat aggregate when air temperature is below 32 degrees F, to keep mortar between 40 and 85 degrees F until used. Do not heat water or aggregate above 120 degrees F. Keep all batches within the same 10 degree F range.
- E. Retempering: Mortar that loses water by evaporation may be retempered after original mixing by carefully adding water and reworking mix to the proper consistency. Do not dash water over mortar. If mortar is pigmented, add coloring agent to retempering water to assure consistent mortar color.
- F. Discard mortar that is not used within 2 hours of mixing.

## 2.6 STONE FABRICATION

- A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.

1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
- B. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.
- C. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples.
- D. Cut stone to produce uniform joints to match existing stone pavers.
- E. Saw stone backs to approximate true planes. Clean backs to remove rust stains, iron particles, and stone dust.
- F. Inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
  1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.
  2. Inspect cobblestones for size, shape, soundness, color, texture, finish, and markings. Grade them for overall uniform appearance when assembled in place in required patterns. Discard and replace stones that do not meet soundness or appearance requirements. If necessary, fabricate new stones to complete the Work.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine surfaces indicated to receive stone paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Where stone paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Examine surfaces to receive stone cladding and conditions under which stone cladding will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone paving.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone paving.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

### 3.3 SETTING STONE PAVING, GENERAL

- A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
- B. Execute stone paving installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set.
  - 1. Use power saws with diamond blades to cut stone. Produce lines cut straight and true, with edges eased slightly to prevent snipping.
- C. Set stone to comply with requirements indicated. Shim and adjust pavers to set stone accurately in locations indicated, with uniform joints of widths indicated, and with edges and faces aligned according to established relationships and indicated tolerances.
- D. Expansion and Control Joints:
  - 1. Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints. Sealant materials and installation are specified in Section 079200 "Joint Sealants."
- E. Provide steps made of pavers as indicated. Install paver steps before installing adjacent pavers.

### 3.4 MORTAR-SET STONE

- A. Where not otherwise shown or specified, mortar-set flume, steps, walks, ramps, copings, and wall cladding base courses as follows:
  - 1. Thoroughly clean substrates. Saturate concrete substrates with clean water several hours before installing mortar bed; remove surface water and coat substrates with a neat Portland cement paste. Spread and screed setting mortar while paste is still plastic. Scrape off and replace paste that dries before setting bed is placed.
  - 2. Drench stones with clean water before setting. Where not otherwise shown, set stones in full beds of stiff mortar; adjust stone spacing, level, and alignment while mortar is still plastic. Use permanent spacers under heavy stones to prevent mortar extrusion.
  - 3. Keep expansion joints free from mortar and non-compressible materials by building in compressible cork strips. Where not otherwise shown, fill other joints in mortar-set stone with setting mortar and rake face joints for pointing.
  - 4. Fill spaces behind stone steps with setting mortar; leave no voids. Where not otherwise shown, fill spaces behind mortar-set cladding base courses to weephole level with setting mortar; slope fill to drain.
  - 5. Pointing: Point joints with at least three layers of pointing mortar. Tool each layer when pointing mortar is thumbprint hard. Tool the surface slightly concave.

### 3.5 PEDESTAL-SUPPORTED STONE PAVERS

- A. Layout: Establish a baseline and lay out joint lines straight and square with the principal axes of each area.
- B. Pedestals: Construct cast-in-place concrete pedestals in accordance with Section 033000 "Cast-In-Place Concrete." Where cleanouts and junction boxes occur, construct pedestals that

encapsulate cleanouts and boxes and provide minimum 3 inches perimeter support for stone. Use a compatible bonding agent, recommended by the waterproofing manufacturer, to bond pedestals to waterproofed concrete surfaces. When pedestals are cured, adjust top elevations with non-shrink grout or mortar made from sanded epoxy resin adhesive. Mix, place, and cure grout/mortar per manufacturer's instructions.

- C. Stones: Cap pedestals with cushions and install stones. Lower stones carefully; do not "nose" them into position. Distribute stones of varying color and texture throughout walkway area to produce an overall uniform appearance, free from shading. Produce smooth-surfaced walkways that are free from lipping and offset joints.

### 3.6 COBBLESTONE SURFACING

- A. Install stones in required patterns, so that widths of open joints are approximately equal and cumulative error caused by varying paver size does not noticeably affect surfacing patterns.
- B. Anchor cobblestones to waterproofed pool bottom and fountain grid with epoxy adhesive. Mix and apply epoxy adhesive in strict accordance with the manufacturer's instructions. Mix only as much adhesive neat for thicknesses/clearances up to 1/8 inch. Blend in fine aggregate for greater clearances/thicknesses.

### 3.7 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.
- B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.
- C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.

**END OF SECTION 321440**